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NOTE.—References to Insects and Fungi are indexed under the headings "Insects" and "Fungi" only, to Weeds under the heading "Weeds" only, and to Diseases of Animals under "Diseases of Animals" only.

Editorial Notes are indexed under the subjects to which they refer.

To avoid confusion in reference the term "Ministry" is used throughout, with a very few necessary exceptions, although the word "Board" may appear in the text.

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THE JOURNAL OF THE MINISTRY OF AGRICULTURE

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NOTES FOR THE MONTH.

THE scheme for the formation of Agricultural Credit Societies under Section 2 of the Agricultural Credits Act has made little progress up to the present. One obstacle has been the rate of interest on advances by the Ministry to societies, which on the initiation of the scheme was fixed at 5 per cent. This has now been reduced to current Bank Rate with a minimum of 4 per cent., so that this obstacle has been removed. A leaflet has been issued explaining the method of forming societies, and if the scheme outlined in the leaflet were taken up it should prove of great advantage to small farmers and others in enabling them to purchase live stock and requirements on extended credit. It is not usually practicable or desirable for a society to be formed exclusively of prospective borrowers, and the method suggested in the leaflet is that such societies can best be promoted through the agency of existing co-operative societies or other organisations, who will take up shares in the Credit Societies without being actual borrowers. Under such an arrangement the share capital subscribed by the co-operative society, or other organisation, combined with the shares taken up by prospective borrowers and with the proportionate Government advance, would put the society on a sound footing.

The following extracts from the leaflet may be quoted:—

The method provided by the Act involves the establishment of Agricultural Credit Societies which are financed partly by the paid-up capital on shares taken by members and partly by money advanced by the State.

Although the Government advance to a society under the Act is on a very liberal scale, it must be remembered that a society cannot, as a rule, be formed exclusively by borrowers.

This difficulty can be got over either by inducing persons to take shares in the society who do not themselves wish to obtain loans, or by each member taking more shares. As the persons who join the society for the express purpose of obtain-

ing loans will not usually wish to invest more money in the society than is necessary, the former method is the one which must in ordinary cases be adopted.

As it may not always be easy to find persons who, without any direct benefit to themselves, are willing to invest money in Co-operative Credit Societies, the Ministry think that the most hopeful method of proceeding is through existing Co-operative Trading Societies. The object of the loan in the majority of instances will be to enable the borrower to purchase agricultural requisites such as fertilisers, seeds, live stock, implements, etc., and the natural course is to adapt the scheme to the ordinary conditions of trade so that the loan and the purchase (which is the object of the loan) are made through the same channels at the same time.

This can be accomplished where a Co-operative Trading Society is prepared to promote a Co-operative Credit Society and to take up shares in it proportionate to the anticipated demand. In such a case a member of the Trading Society wishing to make a fairly extensive purchase of agricultural requisites could take shares in the Credit Society and by a book-keeping transaction would pay the Trading Society for his purchase, the amount being charged to him as a loan from the Credit Society. The adoption of the above proposal by Co-operative Trading Societies would be to the benefit of those farmers and small holders who wished to make purchases on a system of deferred payments as contemplated by the Act, and it would also seem to be to the advantage of Co-operative Trading Societies as it would in effect enable them to provide credit facilities for their customers on a larger scale than they would otherwise be able to offer.

Persons interested should apply to the Ministry for a copy of Leaflet No. 311.

* * * * *

A STATEMENT was given in the March issue of this *Journal* setting out the provisional conditions on which loans will be

Loans to Agricultural Co-operative Societies.

made by the Ministry to co-operative societies engaged in the preparation and marketing of agricultural produce.

The Ministry is now prepared to receive applications, and organisations which desire to make application should apply for a form which indicates the particulars which are required in order to enable the Ministry to consider the matter.

* * * * *

A MODEL which is to be exhibited in the Government Pavilion at the British Empire Exhibition by the Machinery Branch of the Ministry, illustrates up-to-date methods of power farming and a modern type of farm buildings. While the exhibit cannot claim to be exhaustive, it serves as a useful indication of the use of mechanical power for the several field operations, and the utilisation of electricity for operating farm machinery and for other purposes.

**Power Farming:
Model
Demonstration at
the Wembley
Exhibition.**

The field operations shown include ploughing with steam tackle, a method of which Great Britain may perhaps with justice claim to be the home. The tractor will also operate ploughs, including sub-soiling ploughs.* While the practice of sub-soiling is not new, much yet needs to be investigated both as to the best methods of dealing with "hard-pan" soils and the relative merits of sub-soiling proper, which disturbs the under-soil without bringing it up, and deep-ploughing, which bring the lower soil to the surface. The tractor will also be seen working two mowers, a method which trials, conducted in 1922, proved to be very economical on fairly large areas.

It will further be seen with a hay-loader and, as an object lesson of what will not pay, with a single binder. A single binder is not a sufficient load for a tractor, and when a tractor is not working up to its full capacity there is necessarily a waste of fuel. The draw-bar pull for two binders in a heavy crop of wheat is approximately 1,250 lb., which is well within the capacity of the average tractor. A tractor with two binders, given a field sufficiently large for their operations, may be expected to effect a saving of about 15 per cent.

The tractor will also be shown operating a mole-plough which gives occasion for an exhibit illustrating the benefits of drainage generally, whether the less expensive process of mole-ploughing, or the more costly, but highly remunerative method of tile draining be adopted. Two miniature plots will be included, one drained, the other undrained, and the effects of a system of drainage on the hay crop will be demonstrated.

The other section of the exhibit—that which shows the farmstead—should prove particularly attractive. It is naturally impossible to prescribe any one type of arrangement as generally suitable. Much will necessarily depend on the natural

* Accounts of the trials in sub-soiling which are being conducted by the Ministry have appeared in the following issues of this *Journal*: Jan. 1923, p. 911; Feb. 1924, p. 1000.

features of the situation, something too on individual predilections. Again, the extent of the acreage to be served by the farmstead is an important point to be considered. The exhibit will illustrate the best methods of securing the three main essentials, both for man and beast, of light, ventilation and sanitation, and will give some indication as to how, by careful arrangement of all the various buildings, the most efficient and least costly working may be secured. The farmstead is arranged in the form of a rectangle or court—forming an open yard—rather to the back and to the side of the dwelling house. The dwelling house is shown facing south. It is equipped with a wireless installation for the receipt of weather reports, with a private telephone exchange connecting all the various buildings, and with electricity for lighting and heating.

The same care has been taken in the model as should be taken in actual practice in the arrangement of the dairy building. This is as it were a factory for the production of human food and the sanitary requirements of light, ventilation, drainage and cleanliness can never be too pointedly emphasised. The building (as careful observers will gather from the weather-vane on the farmhouse) has its main axis lying north and south, this position being most convenient to ensure that as much direct sunlight as possible shall reach the stalls during the course of the day. The stall fittings are constructed of steel, with concrete mangers and floors.

To the casual observer of the ordinary farm nothing perhaps used to appear so neglected as the farm implements. These, however, are ceasing to be the simple inexpensive appliances which served our forefathers, and both on account of their cost, and in the interest of their prolonged efficiency, require careful and adequate housing.

The power-house, which is also shown, is quite a modern addition to the farm. The power will be provided, in this case, by a windmill of the Airolite type, provided with storage batteries. In the rickyard will be noticed a thrashing machine with stack-feeder and elevator driven by a tractor. Here also will be illustrated the new method of drying crops by artificial means, in which experiments were last year conducted by the Ministry. There will also be shown a model silo with silage cutter and blower elevator complete. The barnyard is provided with tramway tracks, with trolleys for the conveyance of food and manure.

* * * * *

ARRANGEMENTS are now well advanced for the fourth International Seed Testing Congress which is to be held in London and Cambridge during the second week of July next. Most of the principal countries in the world, and in particular those where an Official Seed Testing Station is estab-

**International
Seed Testing
Congress.**

lished, have appointed official delegates to attend. The organisation of the Congress, which is on similar lines to that of the previous International Seed Testing Congress held at Copenhagen in 1921, is being carried out by a small Committee set up by the Ministry of Agriculture and Fisheries. Most of the meetings will take place at the National Institute of Agricultural Botany, Cambridge, and papers on various phases of seed testing will be contributed by certain of the delegates, and subsequently discussed. In addition, visits to the British Empire Exhibition at Wembley, Rothamsted Experimental Station at Harpenden, and the School of Agriculture and other places of interest in Cambridge will be organised.

* * * * *

MILK records which are taken under the auspices of the local societies operating in connection with the Milk Recording Scheme of the Ministry often show surprising results, and, as an illustration of what can be achieved by attention to records and care in management, the following case will commend itself.

**A Fine
Milking Record.**

Mr. T. Stuart, of New Hall, Sowerby, Garstang, Preston, a member of the Lancashire County Milk Recording Society, owns a non-pedigree Shorthorn cow, "Sowerby Doris," which was bred on the farm. Her sire is believed to have been a Cumberland bull of the Hegglesfoot breed. Contrary to his usual practice of selling cows when carrying their third or fourth calf, the owner decided to retain "Sowerby Doris" in order to test a remark which he had heard concerning this cow's sire, to the effect that the longer the progeny of this bull were kept the better milkers they would be. The following annual and lactation yields confirm the accuracy of this remark:—

					<i>Days in Milk.</i>	<i>Milk Yield (lb.).</i>
Year ended 1st October, 1918	...	...	...	...	274	5,759
" " " " 1919	...	...	...	...	256	6,370
" " " " 1920	...	...	...	...	172	6,695
" " " " 1921	...	...	...	...	246	5,745
" " " " 1922	...	...	...	...	340	17,897
" " " " 1923	...	...	...	...	220	12,857
Period from 1st October, 1923 to 3rd February, 1924	...	...	...	...	136	7,271

		<i>Days in Milk.</i>	<i>Milk Yield (lb.)</i>
2nd lactation, calf born 13th April, 1918 ...		244	5,382
3rd " " " 1st April, 1919 ...		235	6,282
4th " " " 3rd June, 1920 ...		362	11,997
5th " " " 22nd Oct'r, 1921 ...		424	19,066
6th " " " 13th May, 1923 ...		273	18,960

(This last yield was up to 3rd February, 1924, when she was still in milk and giving about 40 lb. per day.)

As will be seen from these returns the cow gave little promise in her early years of being a big milker, and the development is so marked as to be worthy of record. At the time of inspection the cow was reported to be in splendid condition and perfectly healthy, and was expected to pass the 2,000 gallon mark. Mr. Stuart has four other cows from the same sire which have all averaged over 1,000 gallons with their last four calves.

* * * * *

In the spring of 1922 the National Institute of Agricultural Botany, Cambridge, received samples of eight different stocks

**Yields of
Different Varieties
of Lucerne.**

of Lucerne, namely, "Provence" lucerne grown respectively in France, South Africa, Essex, and Northamptonshire, and "Grimms," "Kansas Grown Common," "Dakota Grown Common," and "Peruvian" from America.

These were planted each in a single rectangular plot of one thirty-second part of an acre. Results obtained from single plots can never furnish conclusive evidence of the relative yields of different stocks, nor are two year's trials sufficient to furnish more than an indication of their comparative merits; but the results have been so consistent and of such practical interest that it is considered that a preliminary note should be published forthwith. A further inducement to its publication is furnished by the fact that the results coincide in all essentials with unpublished data received from Essex and Lancashire.

One cut only was obtained in 1922, while four cuts were taken in 1923. In each year "Provence" from Essex seed gave the biggest crop, followed by "Provence" from French seed, with that from Northampton-grown seed third. In 1922 South African-grown "Provence" came fourth, but in 1923 it did so badly that it dropped to seventh place, and its total yield for the two years is only a little over half of that of the average of the other three Provence stocks. "Grimms," which has created such a favourable impression in the United States owing to its hardiness, has not shown promise in the present trials,

starting its growth late and finishing early, and only taking fifth place in total yield.

The good showing made by English-grown stocks is interesting, but little can be hoped from this at the present time. It is only once in every five or six years that weather conditions in this country allow the harvesting of a seed crop of any of the existing forms of Lucerne, and in these circumstances the supply cannot be a large one.

It would appear, therefore, that unless plant breeders can procure, either by breeding or selection, a more rapidly maturing form of Lucerne without loss of yield, the farmer will be compelled, as heretofore, to rely on foreign seed. All the available evidence would suggest that buyers, when English-grown seed is unobtainable, should insist on seed grown in the Provence district of France as being the most suitable for sowing under English conditions.

* * * * *

THE general level of prices of agricultural produce during February remained at the same figure as during January, 61 per cent. above the level in the corresponding month in the years 1911-13. In February last year prices were 63 per cent. above pre-war.

**The
Agricultural
Index Number.**

In the following table are shown the percentage increases monthly since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911-13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	61
March ...	189	150	77	59	—
April ...	202	149	70	54	—
May ...	180	119	71	54	—
June ...	175	112	68	51	—
July ...	186	112	72	53	—
August ...	193	131	67	54	—
September	202	116	57	56	—
October ...	194	86	59	51	—
November	193	79	62	53	—
December	184	76	59	56	—

Cereals were all appreciably dearer in February than in January, and are between 40 and 45 per cent. above their value before the War; wheat and barley being considerably dearer than a year ago. Potato prices declined slightly during the first

half of February, but the general level of prices during the month was 170 per cent. above that of the corresponding month in 1911-1913, the full effect of the January advance being reflected in February prices. In February last year potatoes were selling at 5 per cent. below pre-war prices, averaging 73s. per ton as against 208s. this year. Hay remained at approximately its pre-war value.

Index numbers of fat stock of all descriptions show a fall, in spite of the fact that cattle and sheep averaged as much in February as in January; the lower index numbers are due to the fact that cattle and sheep prices normally rise slightly at this season. Fat stock would doubtless have shown a heavier fall but for the occurrence of the dock strike, which caused a temporary shortage of imported meat and a sharp rise in quotations for fat stock. Since the strike ended prices have declined. Pigs were relatively much cheaper than other fat stock in February, the fall as compared with a year ago being nearly 30 per cent.

Dairy produce showed little change on the month, the index number for cheese falling slightly, but that for butter rising. Poultry and eggs were cheaper, although the reduction in the index number for poultry is entirely due to the lower prices ruling for geese.

Index numbers of different commodities during recent months and in February, 1923, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN
THE CORRESPONDING MONTHS OF 1911-13.

Commodity.	1923.				1924.	
	Feb.	Oct.	Nov.	Dec.	Jan.	Feb.
Wheat ...	28	20	22	33	34	44
Barley ...	12	25	25	27	34	43
Oats ...	39	25	24	30	38	41
Fat cattle ...	61	44	47	49	56	54
Fat sheep ...	97	76	77	72	87	75
Fat pigs ..	88	48	47	43	43	34
Dairy cows ...	67	61	57	—	51	48
Store cattle ...	36	27	25	—	35	39
Store sheep ...	100	99	88	—	91	89
Store pigs ...	154	82	75	—	63	50
Eggs...	46	92	92	86	85	75
Poultry ...	80	65	58	77	60	52
Milk ...	90	72	75	90	87	87
Butter ...	72	61	64	68	68	71
Cheese ...	88	76	73	71	76	72
Potatoes ...	—5*	62	80	91	129	170
Hay ...	42	7	—1*	0	—1*	—1*

* Decrease.

* * * * *

AGRICULTURE AND HORTICULTURE AT THE BRITISH EMPIRE EXHIBITION.

SIR LAWRENCE WEAVER, K.B.E.,
Director: United Kingdom Exhibits.

OF all the industries proper to be shown at a great international or inter-imperial exhibition, agriculture is necessarily the most difficult to present in an attractive and convincing fashion. Arable farming takes up more space than any exhibition could provide, and the difficulties are almost insuperable of keeping in an exhibition ground for the usual term, about six months, enough animals to be representative of a country's stock farming. It was done at one of the Paris exhibitions, but the experiment was not wholly satisfactory to those British breeders who sent stock, and the experiment has not been repeated. At Gothenburg last year an important agricultural show was held for a short period in grounds near those of the Jubilee Exhibition, but this was only the annual Swedish function like our Royal Show, enlarged and given an international flavour.

Last autumn it seemed likely that United Kingdom agriculture would be represented nowhere but in the British Government's Pavilion, and there only by the Ministry's official exhibits relating to research and education—that our farming community would take no part or lot in showing to the visitors from overseas how farming stands in the United Kingdom to-day. But, happily, the National Milk Publicity Council, with the co-operation of the National Farmers' Union, and some financial aid from the Development Fund on the Ministry's recommendation, decided to make a demonstration of ideal dairying methods.

The exhibit will be housed in a large and handsome building designed by Mr. Constantine and standing immediately to the south-east of the British Government Pavilion. It will fall under two heads:—production, and handling and manufacture. So far as production is concerned there will be shown an up-to-date cowshed, in which from 10 to 12 British Friesian cows will be stalled for the period of the exhibition. These cows will be utilised to illustrate the production of clean milk. At one end of this building will be a milk room equipped to show how such milk is cooled immediately after milking and, if necessary, bottled; also how all pails and equipment utilised on the farm should be washed and sterilised.

In the main building, which will be devoted to handling and manufacture, there will first be an exhibit of the modern methods

of handling liquid milk. The milk arriving in churns will be tested for quality and purity; it will then be transported by a lift to the top of the building where it will be emptied into a milk tank. From there it will flow to a pre-heater, clarifier, and pasteuriser, and from thence to a holding tank so that it may comply with the requirements of the Ministry of Health for "Pasteurised" milk.

From the holding tank the milk will descend over a cooler. It will then be shown being bottled, the bottled milk eventually finding its way to the cold store. The proper methods of washing and sterilising both churns and bottles will be illustrated also. The whole of the equipment used in this exhibit will be of "pasteurised" milk.

There will also be a working dairy in which demonstrations will be given and where the different varieties of cheese, clotted cream, and soft cheeses will be manufactured. An exhibit of all the different varieties of goods manufactured from milk in this country, including the various forms of hard cheeses, soft cheeses, cream, butter, milk chocolate, dried and condensed milk, and casein products will be arranged.

On the outside of the building the chief dairy breed societies will exhibit photographs of their respective breeds.

In the very notable exhibit of the gas undertakings in the Palace of Industry emphasis will be laid on sulphate of ammonia as our chief fertiliser of home production, and, though there is no segregated exhibit of agricultural machinery, there will be items of interest to farmers scattered throughout the great Palace of Engineering.

Those who are familiar with the experiments made by Mr. Borlase Matthews at Upper Felcourt, near East Grinstead, in the application of electrical power to the work of the farm will be interested in the exhibit of appliances and methods which Mr. Matthews is arranging for the Electrical Development Association on a site to the north of the Government Pavilion.

Poultry will be well represented by an exhibit organised jointly by the Poultry Club and the National Utility Poultry Society. The conception of this live display is to bring before the public a continuous exhibition of pure stock from the leading breeders of the United Kingdom, in a pavilion which is near the farming and forestry exhibits. The birds will be shown in separate compartments, each containing one female (or two) or one male. The names of the breeders and other particulars will be placed on each pen, and the birds will be changed week by week.

In addition to the live stock, which will be representative of all breeds, including ducks and bantams, there will be a small section including models, literature and minor appliances.

There will also be an important private exhibit by Major Dugdale, of Whiteway Farm, Cirencester. A large area will be laid out as a model utility poultry farm with pens of various breeds. Trap-nesting will be in operation, and the latest methods of chicken rearing will be on view. Chicks will be hatching continuously in a mammoth incubator, and the complete cycle of grading and recording will be seen. Major Dugdale will also show an extensive series of photographs of stock-raising and other farming activities.

Horticulture will be well represented, but more fully in respect of flower gardening than of food production. The gardens under the control of the Exhibition authorities have been laid out by Messrs. Milner, Son and White, and an area of nearly four acres adjoining the British Government Pavilion has been allotted to a group of nursery- and garden-making firms organised by a Horticultural Committee under the Chairmanship of Mr. Cuthbertson, V.M.H. I need only refer here to the food production activities that will be shown. There will be small model commercial fruit orchards, representing a two-year planting that is about to come into bearing. The majority of the trees will be low-stemmed and all should be in flower by the opening of the Exhibition, and it is hoped, with good fortune, in fruit by its close. A feature will be made of cordons, and of the inter-planting of soft fruit. A film showing all the operations of commercial orcharding in this country, from planting to marketing, will be on view in the British Government Pavilion.

Nor has forestry been forgotten. A committee, with Lord Lovat as chairman, secured the co-operation of the various societies interested in the development of forestry and the uses of home-grown timber, and has built for England a replica of a sixteenth century timber house, and for Scotland a simple pavilion designed by Sir Robert Lorimer of a type suitable for use as a village hall. These two buildings will be furnished with exhibits illustrating the possibilities of using home-grown timber in many ways, which the vast importation of foreign timbers has made people forget.

I need not enlarge on the Ministry's exhibit in the British Government Pavilion, as its scope was described in the last issue of the *Journal*; but it will make clear the fact that everything that can reasonably be done is being done to promote a solution of present difficulties by improved research and education in

agriculture. Writing with the freedom which belongs to a former servant of the Ministry, and with such experience as comes to one who for five years has occupied the chair of one of the institutions whose activities will be staged by the Ministry, I may be allowed here a parenthetical remark on the relations of Governments and Ministries to agricultural science. I believe that since the war the development of scientific service to agriculture has been fostered as rapidly and as fully as could reasonably be expected, having regard to the size and quality of the corps of agricultural scientists available for the services to be performed, whether in education or in research. I am not persuaded that if another million or so had been available during the last five years, the mechanism of research in the United Kingdom, and the results of research work to be presented to the Empire at the Exhibition, would have been appreciably more notable than the very admirable demonstration which will, in fact, be given. The experience of the United States of America seems to show that no amount of elaborate buildings and costly apparatus can hasten the output of results except in so far as it discovers men of exceptional minds and provides them with the opportunity and means for work. There seems no reason to believe that any important piece of work has remained undone in the United Kingdom by reason of the imperfect sympathies of Government Departments, or that the sinews of war will fail of being provided when the corps of first-rate research workers grows to such an extent that a substantial addition to the funds now available becomes obviously needful.

Perhaps the most valuable agricultural feature of the Exhibition will be the possibility of comparing overseas methods and results in research and education with those obtaining here. As this article will be published before the Dominion and Colonial exhibits have been staged or catalogued, I can only make this point in general terms. It must necessarily be that many of the Dominion exhibits will be of general rather than intimate interest to us. South Africa will present an ostrich farm. The tropical countries will demonstrate the vast range of the raw materials produced by their agriculturists, materials which are the basis of no less vast manufacturing industries within the United Kingdom. Canada will show her almost unlimited possibilities as the granary of the Empire, but her arable problems are not ours. It is rather in the field of dairying and fruit growing that the parallel between home production and Dominion production will be most significant. In the New Zealand Pavilion will be seen a complete model dairy, which will be

purely a New Zealand demonstration in everything but the milk which will be used. It may be hoped that full information will be available not only as to farming and manufacturing methods but also as to packing and marketing. I am told that New Zealand has the happiness to employ both merchant methods and co-operative methods in collecting and disposing of dairy products, without that unhappy clash between the two sorts of interest which has made co-operation in this country an occasion for farming politics rather than an affair of plain business. It will be valuable, for example, to ascertain by association with New Zealanders whether, as is alleged in respect of Denmark, successful co-operation is the child of export trade only or is of equal value in respect of internal marketing.

The same general considerations apply to the growing, packing and marketing of fruit, about which there must be much to learn from the methods of Canada, Australia and South Africa.

The Exhibition indeed offers to the agriculturist and the horticulturist of the United Kingdom an unique opportunity of making a survey of Dominion and Colonial methods, whether in research or education, in cultivation or marketing, with a view to seeing how far the genius of daughter nations has evolved methods which are capable of being grafted on to United Kingdom practice with or without modification.

The Exhibition has provided, as part of the facilities for making the fullest use of this unique assemblage of Imperial products and Imperial men, a group of Conference Halls, and placed them at the disposal of responsible bodies who are concerned to discuss subjects, whether scientific, sociological or economic, which are of vital import to the closer organisation of the Empire and the development of its amazing heritage. Conferences of representatives from all parts of the Empire and of all manner of interests, such as world-power (electric, hydraulic, etc.), mining and metallurgy, textiles, publicity, etc., will be held at Wembley from April to October. It is disappointing to find that no application has been made for these facilities in respect of any agricultural subject, save on co-operation and glasshouse products.

I hope it may yet be possible, when the Overseas agriculturists who are due to come have arrived in England and have become acquainted with us, that some round-table conferences may be held on subjects of common import and interest in the Wembley Conference Halls, if they are then available, but if not, then elsewhere.

This short article is not and does not pretend to be a catalogue of the significant elements in agriculture and horticulture that

are to be seen at Wembley. A hand list would be dull reading and would mean little. It is at Wembley only that the significance of Imperial agriculture can be intimately savoured. The British Empire Exhibition is something more than a gigantic shop window full of such a variety of products as have never more been brought together by the peoples of a single Empire. It is a field of comparative education, and at once a nursery and a clearing house of ideas.

* * * * *

SHORT-TERM LEYS AS AN AID TO ARABLE FARMING.

W. A. C. CARR, M.C., N.D.A.,

Vice-Principal, Cheshire School of Agriculture.

SHORT-TERM leys have been severely criticised by adherents of arable farming, yet the writer ventures to suggest that temporary pasture is the key to profitable corn growing in some northern counties, and there seems no reason why the system should not be extended to other areas where the present depression is acute.

The writer has farming interests, and experience of leys, in Kincardineshire, and the manner in which short-term leys affect the arable crops in the rotation on farms in that county may be of interest. The soil is mostly drift, lying on the Old Red Sandstone; and stiff boulder clay, gravel, and sand, are often found in the same field. On the whole the soil is poor, but where it is composed of the underlying rock it is fairly good. Immediately to the south, the soils improve, and the four-course arable rotation becomes general. On one farm previous to 1912, a five-course rotation, containing a ley of two years' duration, was practised, though on occasion some of the heavy land was ploughed up after the first year's hay crop, and as a result carried an extra cereal crop. Even on the best land, corn crops, following one-year's seeds were almost without exception poorer than crops after two-years' seeds, and the second cereal crop was usually more or less a failure. Not only was the crop poor but the land tended to become foul through growth of weeds. The seeds mixture used until 1911 contained large quantities of Italian and perennial rye grasses, which yielded poor crops of hay and still poorer pasture. This type of ley was really unproductive, though the succeeding crop derived considerable benefit.

When a student at the North of Scotland College of Agriculture, the writer was advised to try another seeds mixture, and this gave astonishing results. Red clover had always failed, absence of lime being erroneously considered the cause, but, without an application of lime, the improved seeds mixture provided abundance of red clover in the hay, and valuable pasture in the second year. The introduction of wild white clover made possible an extension of the ley, which had become profitable, and before the war it was arranged to extend the rotation so that a three-years' ley could be included. The war, however, changed the outlook, and all available land on the farm was under corn, before the inception of the War Cultivation Committee. Good corn crops were harvested during the rotation following the temporary leys, but, when the demand for corn prevented the formation of a ley, the falling off in yield of the arable crops was marked. Nevertheless, although crops were reduced some twenty-five per cent., corn growing remained profitable until prices slumped.

Six-Course Rotation with Three-Years' Ley.—During 1920, before the slump in prices, it was resolved to lay out the land on a six-course rotation, including a three-years' ley, and to effect this it was found necessary to work several fields without the intervention of a ley. Crops grown after corn crops, or one year's seeds, compared with crops following a two-years' ley, continued to demonstrate the value of the ley on every farm. The first field following a three-years' ley was harvested in 1923, and although conditions during springtime were amongst the worst on record, the crop of oats thrashed out at the rate of nine quarters per acre, this being two quarters over the previous highest record of the field, which is one of the poorest on the farm. The variety was "Victory," which had been grown on the field on previous occasions. A six-course rotation is now established, viz. :—

- | | |
|---|-------------|
| 1. Potatoes, turnips and
swedes, silage. | 4. Pasture. |
| 2. Barley or oats. | 5. Pasture. |
| 3. Seeds hay. | 6. Oats. |

The benefit conferred by the temporary ley does not end with the oat crop, as an increase is evident in every crop in the rotation. Potatoes, in particular, revel in the organic matter available after a good ley and in a cold, wet summer, a bit of good turf in the soil is exceedingly valuable. Such diseases as club root and

clover sickness are less prevalent, and many of the troublesome weeds of arable land disappear when pasture forms part of the rotation. Crops may also have a higher feeding value, as according to Collins,* oat straw is usually richer in albuminoids when the crop follows a ley. By extending the four-course rotation to a five- or six-course rotation, through the inclusion of a two- or three-years' ley, the area under roots will occupy one-fifth or one-sixth instead of one-fourth of the farm. Similarly the corn area will be reduced from one-half to two-fifths or one-third. The output of corn from a farm will certainly fall, until the effect of the ley causes an increase in yield, although with a more liberal use of manures it is quite possible to maintain the output on many farms. In fact the whole system tends to be more intensive, as good farmers resent a reduced corn output.

Farmers cannot but agree that leys confer a benefit on other crops, but some may consider the ley itself a doubtful source of profit. If, however, resort to pasture is a panacea for low corn prices, it is difficult to imagine why the ley in the rotation should not be as profitable as corn, unless the ley is so unproductive that it is less valuable than the average permanent grassland in the country. In the north of Scotland, temporary leys, when properly laid down, are more productive than permanent pasture. Such leys have been, and often still are, unproductive, but this is due usually to lack of knowledge or mismanagement, and the writer admits that for ten years he attempted, but failed, to establish a suitable ley. Hay crops were light and it was rare to find an appreciable quantity of red clover. Three acres of pasture were necessary to graze two bullocks, and fattening on a second year's pasture was never attempted. Since 1911, however, seeds have invariably yielded good crops of hay containing abundance of red clover, and when wild white clover is sown, the third year of the ley promises to be more productive than the first or second. Cattle now fatten readily on the pastures, and three acres usually provide abundant food for four animals weighing from eight to ten cwt. each. This would seem a rather better stock-carrying capacity than that attributed to leys in general.

Use of the Ley.—Cattle, when turned out to pasture for feeding, receive a small ration of cotton cake and seldom fail to make a satisfactory live weight increase whilst fattening. The pastures are mostly stocked with feeding cattle which are

* Journal of Agricultural Science, Vol. XII, Part 3.

sold fat in July and August. Lean stores—home bred, Irish or Canadian—are purchased in autumn, and these make good progress on the grass before being tied up for winter feeding. These stores are mostly fattened off during winter, but some of the younger growing animals are carried over, and may go off the grass fat by the end of the following June. It is arranged, as far as possible, to purchase stores when prices are moderate, which is usually during autumn, or February and March. The demand for grazing cattle in April usually exceeds the supply, and it is difficult to make a profit if one purchases at this time. A careful study of markets over a number of years will show that to obtain the best returns from feeding cattle, it is necessary to combine summer and winter feeding, and in order to effect this, either the ley or permanent pasture is necessary.

Leys need not necessarily be devoted to fattening cattle, as in many cases they are used for milk production or for the rearing of stock. The success of Aberdeenshire breeders testifies to the suitability of the ley for the latter purpose.

Seeding and Treatment.—The success of the ley depends largely on the composition of the seeds mixture. Large quantities of rye grass, especially Italian, smother the clovers and slower-maturing grasses. Indeed, the second- and third-years' pasture may be ruined if the total quantity of rye grass exceeds $\frac{1}{2}$ bush. per acre. In the north, experiments usually show a reduction of the hay crop when Italian rye grass is included in the mixture. Cocksfoot is very productive in the second and third years, when given a chance. Experiments at Craibstone have shown that a fairly thick seeding of this grass is necessary if a tufty pasture is to be avoided. Late-flowering red clover, such as that produced in Montgomeryshire, should find a place in the mixture, for, when properly managed, it persists in the pasture for several years. Wild white clover is "worth its weight in gold" as a constituent of a seeds mixture, and to attempt to seed land down for a term of three years without a small quantity of this seed is a great mistake. In fact it should be included in every mixture intended for a two-years' ley. Half-a-pound of seed will cover the ground by the end of the second year where conditions are favourable, and the resultant green manure will benefit the succeeding crop to an extent which will more than pay the cost of the seed.

The seeds mixture recommended is that advocated by Findlay, Aberdeen, and is given in pounds per acre:—

12 lb. Perennial Rye Grass.	1½ lb. Late-Flowering Red Clover.
8 „ Cocksfoot.	1 „ Alsike Clover.
4 „ Timothy.	½ „ Wild White Clover (English).
2 „ English Red Clover.	

On light land the cocksfoot may be increased and the Timothy reduced, and on heavy land, if the tilth is rough, the seeding could be slightly increased. This mixture may not suit all soils and conditions, but it gives excellent results in the north of Scotland and in Cheshire. It has also given wonderful results on extremely poor acid soil in a smoky industrial area near Manchester.*

If hay and pasture is to occupy two or three years of the rotation, then the ley becomes the most important crop in the rotation, and success will not be obtained unless the farmer realises this fact. In general practice the seeds are too often considered of second importance to the nurse crop, whereas if the seeds are to remain down for some time, the nurse crop should, as far as possible, be selected and cultivated to suit the seeds. Heavy clay land must be ploughed early if it is to be seeded down, and it may be necessary to arrange the previous cropping so that the heavy land is cleared in time to be ploughed in the autumn. Where seeds are sown in spring corn, attention to this point may prevent frequent failures, for heavy land ploughed in spring seldom forms a fine seed bed. Wheat, barley and oats make suitable nurse crops, provided they are not forced by excess of nitrogen, or grown on too rich soil. In Cheshire seeds usually “take” better in oats than wheat, and the reason may be that the wheat is often too far advanced when the seeds are sown.

Seeds require a fine but firm seed bed and a light, but thorough, covering of soil, and it is usually advisable to sow at a time when there is sufficient moisture to germinate the seed. A dressing of basic slag or mineral phosphate, together with potash where required, should be harrowed in with the seeds, and if the previous crop has had a dressing of farmyard manure no further treatment should be necessary. If, however, the land is in poor “heart” a dressing of a complete manure containing nitrogen may be applied with advantage. Lime may be applied to the previous crop or at the time of seeding, if an application

* Second Report on Experiments at Taylor Fold Farm, Matley, Hyde, Cheshire County Council.

is considered necessary. On very light soils in dry areas it may be difficult to obtain a good "take" in years of low rainfall, but as the ley would be particularly useful under such conditions, it would be worth a special effort to establish.

Undoubtedly there are farmers who have already tried the ley in the rotation and found it wanting. One must certainly be careful in advocating a system which is not practised in a district, as farmers generally, by experience, find out the rotation which is most suitable for soil and climate. Temporary pasture has generally been found useful in Scotland if the fertile arable soils of Forfarshire and the Lothians be excepted, and it also finds a place in the northern counties of England. Further south one sees little temporary pasture, though in some parts the ley is now entering into the rotation. Even if one assumes that this distribution was economically sound twenty years ago, it may be otherwise to-day, for the approved ley of the nineteenth century cannot compare with that of to-day. The arable farmer expects the ley to accumulate organic matter, and the old-time ley usually failed because it became open in its second or third year. The introduction of wild white clover and a preference for perennial grasses, make possible the ploughing-in of a ley which adds a large amount of first-class manure to the soil at a minimum of cost. In addition, the roots of grasses and clovers improve the physical condition of the soil, whether it be heavy or light; other crops grown for green manure cannot compare with the ley in this respect.

In some areas lucerne or sainfoin might form the ley, and where soil and climate are suitable the cultivation of these valuable crops might be extended.

Adaptability of the System.—The arable area is undoubtedly a national asset, but land is being rapidly laid down to permanent grass. Surely the ley is preferable, if by its use the plough land can be maintained. In the event of war, temporary pasture lends itself to conversion into corn land more readily than permanent grass. Farmers will quickly plough up their leys when corn prices justify the change, whereas it takes more than a rise in the price of corn to bring permanent pasture under the plough. Moreover, crops following short-term leys will yield better than crops grown after old grass land, as wireworms often ruin the latter.

Arable farmers have no need for leys when the price of cereals is high, because lower yields are remunerative. Good soils may continue to yield corn crops which allow a small

margin of profit at present prices, but the increased cost of cultivation is a heavier burden on poor land, and unless the crop is fairly good it cannot pay. In England and Wales the average yield of wheat, barley and oats from 1912-1921 is given as 30.7, 30.8, and 38.3 bushels per acre respectively. Even on low-rented land it does not seem possible that the cost of production could be so low as to leave a profit to the farmer, unless the yield is above these figures. The cost of production is substantially the same for good and for poor crops, and average crops are therefore unlikely to be grown at a profit. Even on poor land the introduction of a temporary ley will increase the yield, without additional manure, and this increase should allow a small margin of profit. In the absence of experimental evidence, it is, however, impossible to estimate with any degree of accuracy the increase in crops attributable to the ley.

The adoption of the ley may present some difficulties. If fields are to be grazed, they must be fenced, and it is almost necessary to have water in every field. Increased capital is also required to stock the pastures, and the cash returns, until the rotation is established, tend to be reduced. These difficulties can be overcome to some extent by mowing the leys, but the price of hay in arable districts is often low and the returns could hardly compare with grazing.

The system can of course be tested in any arable area by seeding down a single field on the lines indicated. It is, however, useless to leave a field seeded with Italian rye grass for an extra year, as this does not constitute the type of ley advocated in this article.

The writer does not claim that the ley will solve all the problems of the arable farmer, but temporary pasture certainly helps some farmers to carry on, and it seems reasonable to think that it would assist others.

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WHEAT POOLS IN AUSTRALIA.

THE system of selling wheat through State-controlled pools was initiated in Australia in respect of the 1915-16 crop, in consequence of the abnormal conditions of the trade resulting from the war. The scheme was entered into by the Governments of the Commonwealth, and the States of New South Wales, Victoria, South Australia, and Western Australia, for the purpose of realising to the best advantage the wheat har-

vests of the respective States, and for making advances to farmers pending the realisation. Subsequently, it was decided that the 1916-17 harvest, and later the 1917-18, 1918-19, 1919-20, and 1920-21 harvests should be dealt with on similar lines. The general outline of this scheme is stated in the official Year Book of the Commonwealth of Australia, to be as follows:—

1. All growers were to participate equitably in the realisation of the harvest and the proceeds thereof.

2. The limited freights available for export of corn were to be allotted between the States, in accordance with the exportable surplus of each.

The securing and general allotment of freight was under the control of chartering agents who were responsible to the Commonwealth Government.

The duty of realising the crop was placed in the hands of the Australian Wheat Board, consisting of ministerial representatives of the Governments of the Commonwealth and the respective States, and one representative of the growers from each State. The Board was assisted by an Advisory Board, consisting of well-known wheat shippers, and the distribution of freights amongst the respective States was undertaken by the Wheat Board. As the United Kingdom was the chief export market for Australian wheat, and London the chief port, a London Wheat Committee, consisting of the High Commissioner, and the Agents-General of the States concerned, acting with the advice of the London representatives of the wheat shippers, arranged the overseas sales.

The Australian Wheat Board fixed all prices at which wheat might be sold, except in the case of poultry feed, which was left to the individual States to regulate at their own discretion. Each State has a local Board or Commission to control the operations of the Scheme within its area, and the local Board effected all local sales, including sales to millers. Agents of the State Governments were appointed to receive wheat on behalf of their respective Boards, and these agents were usually merchants, millers, or other authorised persons, having facilities for receiving, storing and shipping wheat, and were required to furnish adequate bond. On receipt of the wheat, the Government agent issued a storage certificate showing the quality and quantity of wheat delivered. On shipment of the wheat, the agent handed the shipping documents to the Minister, for transmission to the London Board or other overseas agents.

Under arrangements with the Australian banks made by the Commonwealth and State Governments, advances were made to farmers upon delivery of their wheat at railway stations to the appointed representatives.

The proceeds of wheat sales were applied, as realised, in in reduction of the bank overdrafts which had been used for payment of advances and expenses. The rate of interest payable to the banks was 5 per cent. in respect of each of the crops up to 1919-20, and 6 per cent. for the 1920-21 harvest. The Government of each State had undertaken to repay all advances made on account of the State, and the Commonwealth Government had guaranteed repayment by the States.

With regard to the advance made to growers, this varied from year to year. The advance in New South Wales, for example, was 4s. 10d. per bushel in respect of the 1915-16 crop, 3s. 3d. for 1916-17, 4s. for 1917-18, 4s. 10d. for 1918-19, 7s. 6d. for 1919-20, and 6s. 3d. for 1920-21. The advances are made by means of certificates issued by the appointed agents, payable at banks named by the growers.

In all the States, certain wheat, particularly seed wheat, was not brought under the Scheme. The quantity of wheat pooled consequently differed from that harvested in each State. The pools were not, however, solely restricted to wheat grown in the particular State, but wheat grown in one State was permitted to be sold through the pool of another. A considerable quantity of New South Wales wheat was, in this way, disposed of through the Victoria Pool. The wheat pooled in each State for the 1920-21 crop (up to 1st August, 1921) is indicated in the following figures :—

New South Wales	...	50,982,000	bushels.
Victoria	... ..	38,563,000	„
South Australia	... ..	31,833,000	„
Western Australia	... ..	10,475,000	„
Total		131,853,000	„

The original scheme, which underwent certain modification in respect of harvests subsequent to 1916-17, came to an end with that of 1920-21. In 1922 the compulsory pooling of wheat was abandoned, but the principle of pooling the exportable surplus was continued on a voluntary basis under the respective State Governments acting independently of each other. Under this scheme, as in the case of the compulsory scheme, each State

ultimately receives, in respect of the grain actually shipped, the average net profit from the overseas realisations which, after paying expenses, is distributed *pro rata* amongst the growers.

Under the latter scheme the organisation for marketing the exportable wheat is roughly as follows :—

There are three wheat pools : (a) Victoria, (b) South Australia and New Zealand in conjunction, (c) Western Australia. Growers are free to dispose of their produce to the State pool of their own Government, or to that of another State Government, or not, as they choose. In respect of each pool there is established a Wheat Board, analogous to the Australian Wheat Board referred to above, which is responsible for the purchase, collection, storage, financing, shipping and marketing of the grain. Under the Wheat Board an agent is appointed to purchase wheat from the growers, making, on behalf of the Board, an advance for the wheat received of about 3s. per bushel. The agent receives the grain from the grower, usually in bags at the local railway station, and ships it to the port. These agents, who are mainly drawn from the principal firms engaged in the grain trade prior to the starting of the pooling system, are under State control, and are allocated certain districts from which they are authorised to collect wheat under the scheme.

This system of pooling still remains in operation, and the grain exported to the United Kingdom is distributed in this country through the "Australian Wheat Pools Agency," consisting of three firms, which receive and market the whole of the wheat exported by the respective Wheat Boards, operating upon the British corn exchanges, mostly in London.

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THE DEVELOPMENT OF AGRICULTURAL COSTINGS IN DENMARK.

THE WORK OF THE DANISH BUREAU OF FARM MANAGEMENT.*

For some years past an interesting experiment in agricultural costings has been proceeding in Denmark and the results are of considerable interest to agricultural economists outside that country. Indeed, the work that is being carried on by Professor

* Undersøgelser over Landbrugets Driftsforhold, VI, and Meddelelser fra Det landøkonomiske Driftsbureau, 6. Meddelelse, 10, December, 1923, issued by Det landøkonomiske Driftsbureau.

Larsen at the Danish Bureau of Farm Management has already ceased to be entirely experimental and is rapidly taking a definite place in the machinery of agricultural administration and intelligence in Denmark.

The History of the Experiment.—The definite movement towards the adoption of modern methods of book-keeping among Danish farmers, and the introduction of a system of agricultural costings, may be traced back to the efforts made as early as 1890 by some of the local agricultural societies to encourage farmers to keep proper accounts by making an approved system of book-keeping one of the conditions with which farmers had to comply who entered for the competitions organised by these societies. Some of the societies, too, helped on the movement by preparing for their members model forms of account specially adapted for particular types of farming. The Co-operative Agricultural Association in Zealand, for example, distinguished itself by the work it undertook in the years 1904-1910 to determine the best method of book-keeping for those farmers who were desirous of adopting a costings system applicable to farm crops. The practice spread of making farming accounts an essential feature in the competitions organised by the leading agricultural associations, and the work of propaganda was largely aided by the agricultural schools and institutes which gave farm accounting a leading place in their curricula.

It was gradually found, however, that something was wanting in the system of agricultural account keeping in Denmark, and that what was missing was a method of organisation. How this organisation or directive influence was to be supplied was a question to which it was not easy to provide an answer, and consequently, in 1910 the Royal Danish Agricultural Society set up a Committee to investigate the matter. This Committee was specially authorised to draw up rules for the keeping of accounts applicable to both large and small farms, and, further, to make recommendations as to the best way of placing the organisation of agricultural accounts in the country on a basis which would be both stable and adaptable to modern requirements. In 1913 the Committee produced a report, and shortly afterwards account-books drawn up by it were published and were widely circulated.

The most important result of the deliberations of this Committee was, however, the birth of the idea of a central bureau to deal with agricultural accounts. This project became a topic of general discussion in interested circles, and at a meeting of the Royal Danish Agricultural Society held in November, 1915,

it was resolved that a plan for the establishment of such a bureau should be worked out in consultation with all organisations that were concerned with the proposal. In May, 1916, a special sub-committee of the Society was appointed to prepare a detailed scheme of working, and in January, 1917, the proposals made by this committee were accepted by the Society. Pending the establishment of the Bureau, the special sub-committee of the Society proceeded with the collection of material for the use of the Bureau, and commenced the analysis of accounts on the lines that it was proposed should be adopted by the Bureau. In the spring of 1918 the Bureau was definitely set up as an independent organisation, and at once proceeded to function. An annual subsidy of 12,000 kr. was granted by the State; this subsidy was increased in 1919-20 to 15,000 kr., and for the current year the subsidy will amount to 50,000 kr.

Organisation of the Bureau.—The Bureau is managed by a Committee, on which serve representatives of the Central Danish Agricultural Co-operative Association, the Royal Danish Agricultural Society, the Co-operative Association of Danish Small-holders, the Statistical Department of the Danish Government, and similar bodies. The Director is Professor O. H. Larsen, who is also a member of the Committee, and he is aided by a Deputy-Director and seven or eight assistants. The offices of the Bureau are situated in Copenhagen. Apart from the State subsidy already referred to, the Bureau obtains some revenue from the sale of account-forms and by directly managing the books of certain estates and large farms. Payment is made by the Bureau to the local societies for each completed account sent in at the rate of 10-15 kr. for each account.

Method of Obtaining Accounts.—The method adopted of obtaining accounts for the Bureau is by means of a system of local societies which, in connection with farm institutes and agricultural associations, have been set up by farmers expressly for the purpose of providing assistance in the keeping of accounts and of rendering it possible for individual farmers to obtain the help and advice of an expert agricultural accountant. Of these societies there were approximately 60 in existence in 1923. It is the usual practice for the accounting societies to appoint an accounting officer, whose duty it is to assist the members of the society to keep proper accounts and to examine the progress made by them from time to time. At the end of the financial year the accountant conducts an audit, and places himself in a position to be able to certify that the completed accounts are

accurate in all particulars. Some of the accounting officers employed by the societies find it possible to keep going about 30 separate farmers' accounts. In normal circumstances the accountant makes a personal visit to each farm, the accounts of which are under his charge, once or twice a month. Financial assistance is afforded by the State to those societies that are prepared to comply with certain conditions, which require that the system of accounting adopted should be an approved one, that the accounts kept are not restricted to particular branches of farming, and that the results obtained shall be available for publication if required.

The Central Bureau and the Local Societies.—The Bureau of Farm Management keeps in close touch with the local societies by means of the expert accountants, who are able at all times to communicate with the Bureau on points of difficulty that arise, and who attend annually a three days' conference, at which the work of the preceding year is discussed, improved methods of agricultural costings are considered, and the lines of the forthcoming year's activities are laid down. The Bureau also undertakes the direct supervision of the accounts kept on certain estates and larger farms, and in this way is enabled to keep in close touch with the actual details of some part of the accounting work that it organises and directs. Only a proportion of the separate accounts that are kept by the farmers who are members of the local societies are used by the Central Bureau in their annual economic analysis of the position of Danish agriculture. In 1922-23, for example, the total number of accounts which were kept in association with the 60 existing local societies was approximately 2,500, of which it may be expected that between 500 and 600 will be included in the final costings analysis issued by the Bureau.

The Publications of the Bureau.—Although the Bureau has only been in existence for a few years, it has already earned a well-deserved reputation for the excellence of its publications. The Sixth Report of the Bureau, which includes the results of the investigations for the year 1921-22, is a noteworthy contribution to the literature dealing with the economics of the farm. In the 190 pages of the Report, the 500 accounts analysed have been considered from every possible point of view; such questions as the amount of capital employed on farms of various sizes, the comparative working expenses on farms in different parts of Denmark, the gross output per hectare on different sized farms, the gross and net profit earned on various sized holdings, and

the remuneration obtained by the small farmer who employs no labour other than his own family, all receive detailed examination. When it is realised that the Report includes no fewer than 76 summary tables, of which many give comparative figures for a series of years, in addition to special tables furnishing information for each of the 500 accounts included in the analysis, it will be seen that Professor Larsen has spared no pains to place all the information so laboriously collected at the service of agricultural economists.

The Chief Results of the Investigations.—It is, as a general rule, the prosperous farmer who is willing to keep and furnish accounts, and should results become less favourable a farmer who has in past years been a member of a local accounting society frequently resigns from the society. This has an unfortunate result on the continuity of the material with which the Central Bureau has to work, and, indeed, it is rare to find that a farmer who furnished accounts in 1917-18 is also furnishing accounts in 1921-22 or 1922-23. In view of this fact, the results that may be deduced from the information which the Central Bureau has made available are likely to appear as rather more favourable than is really the case, and the accounts which are shown may be regarded as being applicable to farmers who are in a superior class, both as regards scientific knowledge and business aptitude.

After having been winnowed by the Central Bureau, the number of accounts actually included in the tables printed in the reports for 1921-22 was 500. This number shows a considerable increase on that for the previous years, as will be seen from the following table, which shows the number of holdings of each size in each area for which the accounts were examined by the Bureau :—

	1917-18.	1918-19.	1919-20.	1920-21.	1921-22.
Under 10 ha.*	14	24	35	47	40
10-20 „	42	51	67	90	89
20-30 „	68	78	83	111	120
30-50 „	70	95	108	121	143
50-100 „	29	38	49	60	67
Over 100 „	12	19	29	37	41
TOTAL ...	235	305	371	466	500

* 10 hectares == approximately 25 acres.

The following table gives the results of the examination of the 500 accounts for the year 1921, in respect of the various sized holdings:—

KRONER PER HECTARE.					
	<i>Capital employed.</i>	<i>Gross Yield.</i>	<i>Cost of production (Outgoings).</i>	<i>Net Yield.</i>	<i>Net percentage returned on capital.</i>
Under 10 ha.	3,488	1,247	1,246	1	0
10-20 „	2,896	867	849	18	0.6
20-30 „	2,874	876	825	51	1.8
30-50 „	2,749	784	746	38	1.4
50-100 „	2,485	651	630	21	0.9
Over 100 „	2,494	677	632	45	1.8

Similar figures are available for each year since 1917-18, and these figures have been summarised into one group of holdings showing in £ per acre the capital invested, the gross yield, the outgoings, the net yield and the percentage return on the capital invested:—

£1 PER ACRE, CALCULATED AT PAR.					
	<i>Capital Invested.</i> £ s.	<i>Gross Yield.</i> £ s.	<i>Out- goings.</i> £ s.	<i>Net Yield.</i> £ s.	<i>Percentage return on capital invested.</i>
1917-18	62 18	15 12	10 15	4 17	7.7
1918-19 ...	64 2	19 2	12 6	6 16	10.6
1919-20 ...	63 10	22 16	16 11	6 5	9.9
1920-21 ...	64 8	26 8	21 3	5 5	8.2
1921-22 ...	62 12	18 11	17 16	0 15	1.2

From this table it will be seen that Danish agriculture has had very varied prosperity over the period of years in question, and that in 1921-22 the position of the Danish farmer was a very serious one. In 1918-19, on the other hand, the return that he received for his work was very substantial.

In looking at the above table it has to be borne in mind that the capital invested includes the capital value of the land, buildings, equipment and stock of all kinds.

When examined in detail it becomes evident that the most important result from the farmer's point of view, of his operations in 1921-22, was the drop in gross output per hectare as compared with the year 1920-21. On the average the gross output showed a decline from 1,185 kr. per hectare in 1920-21 to 831 kr. per hectare in 1921-22, or a reduction of 30 per cent. This result is largely due to the pronounced fall in the prices of agricultural products during the latter half of the financial year 1921-22; another contributing factor in some parts of the

country was a comparative failure in certain crops. To counter-balance to some extent the drop in gross yield between 1920-21 and 1921-22, there was a drop in working costs of 151 kr. per hectare. This reduction is due partly to a decrease in wages paid to labour and partly to a fall in the price of feeding stuffs and other commodities.

The net yield to the farmers in 1921-22 was very poor indeed. The detailed figures published by the Bureau make it clear that in the case of the small holdings, there was no net yield at all. Apart from this class of holding, however, there was no essential difference between the yield obtained on medium-sized holdings and on large farms.

The Bureau has recently issued a preliminary statement covering the analysis of about 200 accounts for the year 1922-23. These show that the net yield per hectare has risen from the low average figure of 33 kr. in 1921-22 to 140 kr. in 1922-23, while the average percentage return on capital invested has risen from 1.2 to 5.4. These figures would appear to indicate that agriculture in Denmark is on the road to recovery after the decline in 1921-22.

It is in arriving at general conclusions on the way in which small, medium and large holdings are affected by varying economic conditions, that the work of the Bureau is of such great value to the agricultural economist at present. When to the series of figures at present available, further years have been added, the value of the results obtained by the Bureau will increase to an extent that can only be realised by those who have searched for, and failed to find, reliable costs data for agriculture extending over a reasonable period of years.

* * * * *

HOARY PEPPERWORT: A WEED MENACE IN THE S.E. COUNTIES.

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Ministry of Agriculture and Fisheries.

With Drawings from Nature by BERTHA REID.

HOARY Pepperwort (*Lepidium Draba*, L.), a perennial weed of the mustard and charlock order, and variously known in Essex and Kent as chalk weed, Thanet weed, hoary cress, whitlow pepperwort, white weed, and devil's cabbage, has in recent years become a most disturbing factor in Essex and Kentish farming. It is clear that this obnoxious weed is spreading in

these two counties, and it is certainly desirable that every farmer should be made familiar with it. Those who have unfortunately come into practical contact with this weed regard it as a serious menace, for it has caused heavy losses, and is costly to tackle. Farmers in all counties, but in Essex and Kent particularly, would be well advised to keep their eyes open for its first appearance and then give it no chance to become established.

Distribution.—The distribution of this weed in England was discussed in April of last year at the School of Agriculture, Cambridge, at a meeting attended by a number of County Organisers and County Officials. Professor Biffen emphasised the dangerous menace to agriculture which the spread of this weed constitutes. Thirty years ago it was one of the rarest plants in East Anglia, but its presence as far north as Norfolk has now been notified. It has certainly been found as a weed of cultivated land in Essex for somewhere about 35 years, though it seems probable that it has only become widely troublesome in the last 15 years. Its virulence in Essex and Kent is well known. It has also (1923) been found in Buckinghamshire, at Wendover.

Hoary Pepperwort has travelled from the old world right across the United States to California, which it seems to have reached some 17 years or so ago, and is becoming one of the worst plant enemies of the sugar beet grower. The weed is also very prevalent in parts of New Zealand, and is widely spread throughout Victoria, where it is a proclaimed weed under the Victorian Thistle Act.

Hoary Pepperwort must be regarded as an "alien" in Britain, though it is a common weed on the Continent. According to a communication from Mr. E. E. Turner, well-known as an authority on the Essex flora, to Mr. R. Robson (East Anglian Institute of Agriculture, Chelmsford), the weed was introduced in 1809 by troops returning from the Walcheren.

Seed.—The seeds (Fig. 1, a) are about one-twelfth of an inch long (1.5 to 2 mm.); broadly egg-shaped, sometimes slightly tapered, may be slightly compressed; dark brown, brown to purplish; surface dull. According to Burchard* the seeds are found here and there in mid-European red clover seed. In the United States they occur in Lucerne samples.† During the

* O. Burchard, *Die Unkrautsamen* : Berlin, 1900.

† 22nd An. Rept., Agric. Exp. Sta., Univ. of Nebraska, 1909.



FIG. 1.—Hoary Pepperwort (*Lepidium Draba*, L.).

a. Seed, nat. size and $\times 5$; *a'*. seed vessel $\times 3$; *b.* early stage of seedling $\times 1$; *b'*. cotyledon or seed-leaf; *c.* second stage of seedling $\times 1$; *d.* third stage of seedling $\times 1$; *e.* flowering plant $\times 1$; *e'*. flower $\times 5$.



FIG. 2.—Hoary Pepperwort (*Lepidium Draba*, L.), showing variation in foliage of mature plants. (About nat. size).

past month they have been found, at the Official Seed Testing Station, in a sample of tall fescue.

Seedlings.—In the seed-leaf stage (Fig. 1, b) the root of the seedling is thread-like. The part immediately below the seed-leaves is whitish to green, stout and smooth. The cotyledons (seed-leaves) are oval, narrowing to a broad petiole (leaf-stalk), and light green above and below, fleshy, about one-third of an inch in total length and one-eighth of an inch broad. The first true leaves (Fig. 1, c) are small, spring from the base, oval to nearly round, narrowing to a broad petiole, light green, smooth, and with a clearly marked midrib. In a rather later stage (Fig. 1, d) the leaves are oval to round-oval, smooth, with a long petiole channelled above, a clearly shown midrib, and some have a slightly irregular margin.

Mature Plant.—Hoary Pepperwort (Fig. 1) has thick cord-like roots, branched stem, and oblong to somewhat lanceolate leaves, the lower of which are shortly stalked and the upper with an arrow-headed base which clasps the stem. It is somewhat variable, however, many plants being much more branched than others, while in some cases the leaves have broken or irregularly toothed margins rather than the usual unbroken margin (Fig. 2).

The small white cruciform flowers are about one-fourth to one-eighth of an inch in diameter, borne on slender flower stalks in broad flat clusters, and the two-seeded pods are thick, nearly heart-shaped, and constricted in the centre. The plant is stout, covered with fine down (though this is variable), and one to three feet in height. It flowers in May and June, and may be spread rapidly by seed and steadily by the root-stocks. Robson says: "Above ground it is as bad as charlock, below ground it is as bad as bindweed." Its appearance when in flower in a corn crop is very striking (Fig. 3).

Soil and Situation.—It appears to invade most soils in Essex, light or heavy, and also most sites, as Robson states: "It can maintain its existence amongst grass and lucerne, and it grows luxuriantly in many ditches, and in waste heaps by the wayside. When the ground is cultivated for corn, etc., it grows vigorously." The long root stocks have been found in the deepest drains, and have been traced to a depth of four feet.

Eradication.—As regards combating the weed generally, the principles on which to proceed may be given as follows:—

1. *Regular and frequent cutting* to prevent seeding and exhaust the root-stocks;
2. Well-hoed root and other crops, and thorough tillage operations;
3. If absolutely necessary, a bare fallow with deep ploughings and cultivating;
4. A smother crop of mustard, vetches, or maize;
5. Spraying as indicated below.
6. Refuse in badly cleaned thrashing machines may distribute the seeds.
7. Seed of local origin should be examined both by vendor and purchaser to ensure that it is free from this weed.
8. The distribution of the weed in seeds hay, clover hay, etc., should be guarded against. The sale of such hay off the farm producing it might lead to serious results—and has probably already assisted in the distribution of the weed.
9. Let farmers co-operate to guarantee one another as far as possible against local distribution of this serious pest.

Experiments conducted by Robson* indicated that spraying the weed (both in the field and along hedgerows) about the beginning of May with 80 gal. per acre of a 4 per cent. solution of copper sulphate (= 32 lb. in 80 gal.); or (preferably perhaps) with 27½ lb. of nitrate of soda and 16½ lb. of copper sulphate in 110 gallons of water per acre, destroyed the weed above ground, and therefore prevented seed production, while the outer leaves only of the cereal crop were killed. In the case of the latter spray fluid the weed was killed to a considerable depth below the soil. It was considered likely that two annual sprayings would be found necessary. A horse-sprayer would be desirable as in the case of charlock.

Spraying trials were conducted in 1921 and 1922 in Kent,† and Garrad's general conclusions indicate that spraying when the plant is in full flower is most effective, destroying the leaves and flowers, preventing seeding, and preventing the smothering of the corn crop. Persistent spraying should gradually weaken the weed. The spray fluids suggested are 40 lb. of copper sulphate in 80 gallons of water; or 2 cwt. of sulphate of

* Control of the Weeds Whitlow Pepperwort and Black Mustard, R. Robson: this *Journal*, Vol. XXVI, Apr., 1919, p. 56.

† Hoary Pepperwort or Thanet Weed, G. H. Garrad; this *Journal*, Vol. XXX, May, 1923, p. 158.



FIG. 3.—Hoary Pepperwort in bloom, as the predominant plant in a corn crop.

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ammonia in 60 gallons of water; or 14 lb. of copper sulphate and 56 lb. of sulphate of ammonia in 70 gallons of water.

After having one portion of a field hand-weeded for 18 years, Mr. John Steel, of Rochford, is stated to have kept the weed to its original area, but it still continued to grow!

It should be strongly emphasised that the roots penetrate deeply and widely, and the plants produce an abundance of seed, and exertions must be continuous if rapid multiplication is to be avoided.

Hoary Pepperwort has caused heavy losses in California, and the Californian experience is of interest. In the *Monthly Bulletin* of the Department of Agriculture for that State (Feb.-March, 1922) it is recorded: (1) that it suffers readily from drought, and "in a drought-weakened condition is killed easily by close cutting"; and (2) that "for the underground stems, thorough cultivation through an entire season will do much, and probably a second season of the same thorough work will finish the job in a given location." It is there found that in a crop like sugar beet, hand pulling is about the only measure practicable, care being taken to pull up as much as possible of the rootstocks. The Bulletin referred to partly says: "Efforts to control this now recognised pest failed and all the outside aid obtained was the name and the information that it was a difficult plant to eradicate."

"It was soon realised that infestation by this plant made summer crops difficult, then unprofitable, and finally, in many cases impossible. Hay sold from infested fields spread the infestation and unclean grain added to its distribution." Some farmers sacrificed a whole season to cultivation, to bring the weed under control, and failed. "This result was so discouraging that a second season's cultivation was not attempted although this might have been successful in establishing control." It was introduced to California in lawn grass seeds, lucerne, flower seeds and beet seed, and by flood waters from other districts.

This weed was well known to Mr. Primrose McConnell in Essex many years ago, and he permits me to quote from a letter as follows:—"I never saw or heard of it till I came to this corner of Essex. A neighbour informs me he has dug down 4 to 5 ft. and the roots went deeper still. I have none on my farm as yet, but it is only some fields away. One farmer has sowed down some fields, as his arable crop was smothered with it and it was a hopeless case. Ordinary weeding and cultivation is of no use, and even fallowing fails to kill it: perhaps two years' successive fallow might settle it, but I am doubtful."

THE MANAGEMENT OF AN INSTITUTION FARM.

J. H. MATTINSON, B.Sc. (Agric.),
County Agricultural Organiser, Surrey.

AT the Surrey County Mental Hospital, Brookwood, the farming policy is essentially governed by the needs of the Institution. The purpose of the farm is to provide, as far as possible, all the milk, potatoes, pork, eggs, etc., required, and to utilise the waste material—always a large item where many people are housed and fed.

As it is fulfilling this purpose very efficiently and also very economically, the details of cropping, stocking and general management of this farm will no doubt be of special interest to those responsible for the management of similar farms.

The Institution usually accommodates from 1,200 to 1,400 patients in addition to a large residential staff.

The farm is managed by a sub-committee of four, acting through the steward of the Institution and the farm bailiff, who have kindly furnished the statistics for this article. Broadly speaking the farming policy is decided by this sub-committee, which meets regularly and periodically; at these meetings the schemes of cropping, manuring, marketing, etc., are brought forward and either approved or amended, the details of carrying these out being left to the steward and bailiff who report at each meeting.

The same committee is responsible for the 21 acres of gardens, which are supervised by the steward and the head gardener, and which supply the Institution with fruit and vegetables.

The Farm.—The area of the farm is $153\frac{3}{4}$ acres, of which $81\frac{3}{4}$ are arable and 72 grass. It is situated on the Bagshot Sands within two miles of Bisley and five of the village of Bagshot, to which this geological formation owes its name.

It is well known that, except in favoured parts in valleys where deeper soil has accumulated or where alluvium is present, the soils on this formation are very poor and a great part of the area consists of barren commons and army camps. The soil on the farm under review may be said to be fairly typical of the poor type which abounds in the north-west part of the county, and much of the land, if not highly farmed, would soon revert to something little better than waste land covered with heather. The soil is largely composed of coarse sand with pebbles, and, except in the lower parts, possesses a very small

water-holding capacity and cannot lift water from below in dry times. Its yielding power is therefore very much limited by the amount of rain falling at the right time of the year, and is increased by any amelioration of the soil which increases its water-retaining powers, *i.e.* the frequent application of organic matter in the form of dung, etc. Manures have no lasting effect on this type of soil, and, practically speaking, each crop must be manured individually and not be regarded as part of a rotation. The following will illustrate these points:—

In some grassland manuring trials on a dry part of the farm, the yields of hay from the unmanured plot taken each year in the middle of July have been as follows (the rainfall during the preceding months being given alongside):—

			Yield per acre.		Inches of rain,	
			cwt.	qr.	Feb.—June inclusive,	
1921	...	...	7	3	...	3.78
1923	...	...	22	3	...	9.55

It might be mentioned here that on one of the poor fields in the dry season of 1921, a seeds mixture sown in the spring failed over the whole area with the exception of one strip of land down the centre of the field. Inquiry showed that in the previous winter the farmyard manure for the field beyond had all been carted down this ridge. We may assume therefore that the extra consolidation caused by this heavy carting improved the water lifting capacity of the soil and enabled the seeds to germinate and maintain their existence until the rains came in the autumn.

Grassland manurial trials have shown that applications of artificial fertilisers will increase the yield and improve the quality of the hay, but that their effect is not lasting. Experiments and analyses have shown that the soil has a low content of lime and is poor in all plant foods.

Stock.—*Cattle.*—A dairy herd of 33 cows is kept to supply milk for the Institution. The cows are Dairy Shorthorns with a few Ayrshires and Ayrshire crosses.

It has been the object in recent years to grade up the cows with a view to having a herd of heavy milkers, and for this purpose the yields are recorded by the Surrey Milk Recording Society under the Ministry of Agriculture's Scheme. Poor milkers are weeded out and the heifer calves from the best milkers only are retained to be brought into the herd later on. A pedigree Lincoln Red Shorthorn bull of good origin is being used. In the milk recording year ended 1st October, 1922, the herd average as authenticated and checked by the Ministry of

Agriculture was 7,308 lb., or approximately 717 gallons. This can be considered a very useful average for a herd of this size.

Every effort is made to produce clean milk; the cowshed is good, with water laid on, and a modern clean-milk pail is in use.

The young stock comprise 25 heifers and five weaning calves. All these are home reared and thirteen of the heifers are in calf.

Pigs.—The keeping of pigs is an important branch of the farming at this Institution. Approximately the same number of sows is always kept. The following figures show the stock in 1922 and 1923 :—

		31st March, 1922.		31st March, 1923.
Boars	...	2	...	2
Sows	...	35	...	37
Suckers	...	130	...	94
* Others	...	241	...	226

* With the exception of a few selected gilts these are being fattened for pork or bacon.

The boars are of the pedigree Middle White breed. The sows are largely home bred, and as pedigree boars have now been used for many generations are of a very useful Middle White type. It has now been decided to work up a pedigree herd and five of the sows are pedigree Middle Whites of well-known strains.

Each sow is expected to have two litters in the year, and as far as possible it is endeavoured to arrange for the farrowings to take place from December to February and June to August. Suckers are weaned at eight weeks, and pigs suitable for breeding purposes are selected from them.

Each week two pigs of an average dead weight of 18-19 stone are required by the Institution. Other pigs are sold fat in the market at 14 or 15 stone dead weight at the age of five or six months. Some gilts are sold for breeding purposes.

During the year ended 31st March, 1923, the following were sold or slaughtered for the Institution :—

Sold fat in the market and to butchers	...	...	409
Slaughtered for the Institution	...	...	91
Sold in market...	...	...	4 sows
Sold for breeding	...	...	34 gilts

With the exception of a few pedigree gilts purchased for breeding purposes, no pigs were bought during the year.

Horses.—Eight horses are kept, but two of these are wholly employed carting coal, etc., for the establishment.

Poultry.—About 200 hens and 50 laying ducks are kept, the former comprising White Wyandottes, Light Sussex, Rhode

Island Reds and White Leghorns. All the eggs produced are required by the Institution.

Labour.—The main work on the farm is done by regular hands, vicarious help being given by patients. The work of the latter is not very reliable and has to be organised in gangs and supervised by reliable men. It is useful for such work as potato planting, lifting and sorting, mangold pulling and hoeing, etc. Patients also assist with the pigs and occasionally with the herd.

As regards the regular hands, eleven men are employed. Three of these are in charge of patients working on the farm; three attend to the cows, milk, and fill in their time with seasonal farm work; one is in charge of the pigs; two are carters; one looks after the poultry and does general work; and one is permanently engaged carting coal, etc.

Cropping.—Of the 72 acres under permanent grass $40\frac{1}{2}$ are made into hay each year. For the greater part this meadow land is rather low-lying, and considering the district yields fair crops.

The young stock are sent off the farm for the summer and do not return until the end of September; during this time, therefore, the 33 cows, sows and gilts, have access to about 32 acres of pasture and the aftermath of $40\frac{1}{2}$ acres. The pasture is, however, very poor and cannot be relied on to produce much keep in unfavourable times; it is supplemented by green crops from the arable land fed either on the pastures or more usually in the cow sheds.

On the low-lying meadows applications of basic slag have been found to be the most effective method of improving the herbage, dressings of 5-6 cwt. of a 30-40 per cent. grade being given every three or four years.

The pasture land is much drier and manuring of this is much less effective; occasional liming and frequent small applications of soluble phosphates and potash form probably the most effective treatment. A dry season on these soils burns out fine grasses and clovers, and the surface then soon covers itself with moss.

A relatively large number of cattle, which are chiefly fed on green crops grown on the arable land, graze over the meadows and pastures, and it is their droppings which have gradually added to the fertility of these fields, enabling them to produce more herbage than they otherwise would.

Of the 82 acres of arable 7 comprise land which is unsuitable

for winter cropping; of these 2 acres are irrigated by liquid manure from the buildings, and 5 acres are on land which is naturally wet. This area is cropped specially with such crops as mangolds, spring planted cabbage, maize, kale, etc.

The remaining 75 acres are cropped and manured in the usual way of farm practice, but no strict rotation of crops is followed. Each year it is necessary to grow from 20 to 22 acres of potatoes, of which 2-3 acres are earlies, so that part of the ground has potatoes every third year and part every fourth. A strict rotation is therefore impossible.

The area under the various crops during the season 1922-23 was as follows:—

	<i>Acres.</i>	<i>Soiling Crops.</i>	<i>Acres.</i>
Potatoes	20 $\frac{1}{4}$ *	Maize	2
Wheat	8	Rye	2
Winter Oats	15†	Trifolium	1
Rye	4	Winter Vetch Mixtures	3 $\frac{1}{2}$
Seeds Ley	13 $\frac{1}{2}$	Spring Vetch Mixture ...	1 $\frac{3}{4}$
Mangolds	8		
Cabbage	3		

The soiling crops were followed by 2 acres swedes, 3 acres turnips, and 3 $\frac{1}{4}$ acres kale.

Summarised this is:—Potatoes 20 $\frac{1}{4}$ acres, straw crops 27 acres, seeds 13 $\frac{1}{2}$ acres, roots and green fodder crops 21 $\frac{1}{4}$ acres, part of the last being followed by 8 acres roots and kale.

Of the produce from these crops, the bulk of the potatoes, the greater part of the 3 $\frac{1}{4}$ acres of kale, and practically all the swedes and turnips were taken by the Institution. With the exception of a few potatoes sold for seed all the other produce, including the wheat, was consumed on the farm.

Potatoes.—The requirements of the Institution are approximately $\frac{1}{2}$ ton per day or 180 tons per year, and the average yield in 1922 was 10 tons per acre. The varieties grown are Epicure for earlies, King Edward, Ally, Lochar and Great Scot. Scotch seed is always used, and the ground is well manured, a common dressing being farmyard manure 20 tons, superphosphate 3 cwt., sulphate of potash 1 $\frac{1}{2}$ -2 cwt., sulphate of ammonia 1 cwt.

Wheat.—An area of wheat is always grown, and of late years Yeoman has been found to be very satisfactory.

Winter Oats.—These are grown to provide straw fodder for the cattle and grain for horses. Spring oats are not very satisfactory on this land, and are not now grown here.

* Of this 2 $\frac{1}{4}$ acres were earlies.

† Of this 11 acres were sown with seeds.

Rye.—A small area is cultivated for straw and grain as it grows well on this land, and if there is a scarcity of fodder in the early summer it can be used as green food.

Clover and Rye Grass Ley.—A one-year's mixture is grown containing broad red clover, alsike and Italian rye grass. Two cuts are taken in the summer before the ley is broken up.

Mangolds.—These are used for the cows from Christmas until about the middle of April. They also form part of the ration of the young stock and some are given to pigs. This crop is manured very similarly to the potatoes, except that the sulphate of potash is replaced by the requisite amount of kainit and a top dressing of nitrate of soda may be given at singling time.

Cabbage.—This is fed to the cows from October to December, replacing the green maize in the rations. This crop is grown under the sewage irrigation.

Soiling Crops.—Maize is grown under sewage irrigation and is a most valuable crop on this farm, supplying green food during the period from August to October, when so often the grass is scarce or has lost its succulence.

Strips of rye, trifolium and vetch mixtures are sown in the autumn for early feed from April onwards. Spring vetches with oats are sown in the spring to follow these, and to carry on until the aftermath is available and the maize is ready for feeding in August. These crops are followed by kale, swedes and turnips, the bulk of which is required by the Institution and the remainder is used up as food for stock after the cabbage has been finished and before the mangolds are started at Christmas. Where the pasture is so poor these crops are essential if a large herd of dairy cows is to be maintained on a relatively small acreage. These soiling crops are well manured, receiving a dressing of farmyard manure with the addition of some superphosphate and occasionally a small quantity of sulphate of ammonia or nitrate of soda.

Manuring.—The yields of all crops on the farm have gradually been increased, and there is no doubt that this is very largely due to the great improvement which has been brought about in the condition and texture of the soil by the frequent application of farmyard manure. This supplies the organic matter which is absolutely essential to this soil, helping it to retain its moisture, without which no heavy crop can be grown, however great the application of artificials may be. The application of so much farmyard manure has been made possible by the wintering of a large head of stock. From 8 horses, 60 head of cattle and

about 400 pigs of varying ages, about 830 tons of manure are produced annually; of this 50-80 tons are required by the gardens, the remainder being used on the farm for potatoes, mangolds and soiling crops.

About $12\frac{1}{2}$ tons of artificials, comprising superphosphate, kainit, sulphate of potash, nitrate of soda, sulphate of ammonia and potato fertilisers, are used annually on the arable land. About half of this weight is applied to the potato ground, the balance being used for mangolds, other root crops and soiling crops. Basic slag is applied to the grassland in such a way that the whole is treated about every four years.

Feeding of the Stock.—Horses.—The rations for the horses consist of seeds hay, straw chaff and oats in winter, and soiling crops, hay and oats in summer. All these are grown on the farm.

Cows.—In summer the cows graze over about 32 acres of pasture and $40\frac{1}{2}$ acres of aftermath, and are given the produce of about $7\frac{3}{4}$ acres of soiling crops.

The approximate average per cow is therefore as follows:—pasture 0.97 acres, aftermath 1.23 acres, soiling crops 0.22 acres. The soiling crops providing the continuous supply of green food are rye, trifolium, winter vetch mixture, spring vetch mixture and maize. The cows also receive some concentrates, the quantities being varied according to the milk yield of individual cows.

From October the winter green foods are cabbage followed by kale, swedes and mangolds in turn, the last carrying on until the rye and trifolium are available. Meadow hay, oat straw and purchased concentrates complete the winter ration. The amount of concentrates required per cow for the whole year ended 31st March, 1923, was 0.90 ton, or an average of 5.5 lb. per day.

The food values of these rations have been worked out on several occasions, and it has been found that the cows are being fed for maintenance and milk yield on lines very near to the standard of scientific requirements.

Pigs.—Sows and gilts are kept in the open air on waste and pasture land as far as is practicable. They are brought into the sties to farrow. Pigs for fattening are kept indoors from weaning time. Green food or roots are given throughout the year, and small potatoes from the farm when available. Swill from the Institution is utilised to the full. The ration is completed by purchased foods comprising bran, middlings, barley meal, pig meal, etc.

It was found during the past year that the total quantity of concentrates required for the pigs worked out at an average of 2.86 lb. per day for 276 pigs, a number which comprises sows, gilts, boars and fatteners, but excludes suckers, and is fairly constant throughout the year. This small average testifies to the use made of small potatoes and swill.

Accounts.—Detailed farm accounts are kept, and for this purpose the farm year is from April to March. In many respects this is an advantage as the annual valuation does not then include large sums for hay, straw, corn, potatoes, etc., which would affect one taken at Michaelmas. The farm is credited with the cost of produce taken by the Institution at current wholesale market prices.

Conclusion.—Financially the farm has been a success. Its main source of profit has been from pigs, whose well-known ability to convert swill and waste potatoes into a saleable commodity has been utilised to the fullest extent, as is shown by the small average daily requirement of meals. A further source of profit has been milk production, and on this farm it is due to the high average yield of the herd, furthered by sound feeding on scientific lines. The farm, moreover, fulfils its purpose very adequately, though in many respects it is not favoured by natural conditions, as the soil is poor and dry, and the average rainfall of the district is low. An intimate knowledge of the farm and its methods reveals very clearly how much of its success in all its branches is directly due to the consistent following of a definite policy. A readiness to profit by practical experience and scientific information has always been shown, but no radical changes have been allowed to affect the general scheme in operation which time has shown to be sound.

* * * * *

LUCERNE.

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Welsh Plant Breeding Station, Aberystwyth.

II.

Date, Rate and Methods of Seeding.—It is generally recommended that lucerne should be sown in drills, although when the conditions are favourable excellent stands can be obtained from broadcasting; this latter method, however, should not be employed except when the land is exceptionally free from weeds; under poor and average conditions drilling is much to be preferred.

A grain drill with seeder attachment may be used. In America special alfalfa disc drills are largely employed. The chief merit of drilling is that it affords ample opportunity for hoeing and weeding the crop during its early development, and also ensures proper covering of the seed—the correct depth being an inch or a little under on heavy soils, and about $1\frac{1}{4}$ to $1\frac{1}{2}$ inches on light sandy soils. The seed rates employed vary over a wide range in different parts of the world. In Sweden Witte's trials indicate that for broadcasting about 35 to 40 lb. per acre, and for drilling about 25 to 30 lb. per acre (with the coulters about 10 in. or 13 in. apart), are the correct rates. In America under normal conditions the seed rate for drilling is about 20 to 25 lb., while under irrigation the quantity may be as little as 15 lb. In drier districts in New South Wales the seed rate is often as low as 6 to 8 lb.* The rates for normal conditions are higher than those usually employed in the case of red clover, but somewhat heavy seedings are necessary in order to assist weed repression. The distance between the drills should be sufficient to allow of proper hoeing; thus Witte recommends a minimum of about 10 in. with a range up to 13 in.; distances commonly employed vary from about 6 in. or 7 in. to as much as 21 in. The establishment of a successful stand on a sandy soil has been reported by the Harper Adams Agricultural College, when 20 lb. per acre was sown in drills one foot apart.† Oldershaw‡ recommends broadcasting on heavy clays, since on such soils cultivation is usually difficult and is likely to be injurious to the plants.

Trials conducted in New Zealand have shown the advantage of drilling over broadcasting. At Canterbury plots drilled at 14 in., inoculated and manured, yielded more heavily than those drilled at 7 in. or 21 in. On the unmanured and non-inoculated plots, 21 in. gave the highest yields.§ In America the growing of lucerne in widely-spaced rows has not proved profitable, for the cultivations have then to be continued over the whole duration of the ley and consequently become prohibitive|| while the crop is liable to become very dusty. Fream quotes opinions in favour of drilling at from 6 in. to 8 in., any

* See Whittet, J. N., "The Production of Lucerne Seed," *Agric. Gazette of New South Wales*, Vol. XXXII, p. 105.

† The Harper Adams Agricultural College, "Field Experiments," 1911.

‡ Oldershaw, A. E., "Lucerne as an Alternative to Grass," *Agricultural Gazette*, 25th March, 1923.

§ Ward, F. E.: "Some Recent Lucerne Experiments in Canterbury," *New Zealand Jour. Agr.*, Vol. 24, 1922, p. 226.

|| Oakley, R. A. and Westover, H. Q.: "How to grow Lucerne," *U.S. Dept. Agr., Farmers' Bull.* No. 1283.

greater distance being stated to favour a straggling rather than an upright growth of the plants.* The results at Aberystwyth tend to show, however, that lucerne can be grown by the widely spaced method under general conditions unsuited to the crop and it is a plan worthy of further trial as being of possible value to those who desire, at all events, to grow a relatively small breadth of lucerne only, as an insurance against exceptionally dry years. In the drier regions of New South Wales, it is recommended by Whittet† that lucerne for seed production should be grown in rows spaced by as much as 30 in. to 36 in. when only 1½ lb. to 2 lb. of seed per acre are employed. It is of interest to note that in 1826 Cobbett‡ refers to an area of lucerne grown in Herefordshire “on the Tullian plan” in rows 4 ft. apart, and he remarks that “a good crop of early cabbage may be had between the lucerne rows”—a useful reminder that there are many ways of growing forage crops!

Lucerne should be sown early enough to have become well established before the end of the growing season, and late enough to have allowed ample time for the destruction of weed seedlings before sowing. In this country June is probably the best month for sowing. Trials conducted by Witte at Svalöf from sowings made at seven different dates between 18th June and 15th September showed the best results from the first two dates (18th June and 5th July), with an eleven per cent. drop by 15th July and thence a rapid and progressive fall to 15th September—from sowing at which date no stand was achieved.§

It is not generally advisable to sow lucerne under a covering crop; for one thing this necessitates early sowing and prevents adequate cleaning of the ground; it also necessitates a higher seed rate and tends to interfere with the establishment of a satisfactory stand. The crop should only be sown under a “nurse” crop when the conditions are particularly favourable. Witte’s trials show a decrease of 21 per cent. from three cuts taken in the first two years from sowing under a nurse in comparison with no nurse,§ whilst Wright’s trials in Scotland proved the nurse crop to be destructive to the lucerne.

* Fream, W., “The Cultivation of Lucerne in England,” Jour.R.A. S.E., 1895.

† Whittet, *loc. cit.*

‡ Cobbett’s “Rural Rides.”

§ See Witte, Hernfrid, “Blåluzernodlingen i Nordamerika,” Stockholm-Svenska Tryckeriaktiebolaget, 1921. Note: 316 references to Lucerne literature (mostly American) are given in this paper.

After-Management.—The chief aim of after-management is to keep down weeds and to bring the plants into the best condition for withstanding the winter, both of which are of the greatest importance during the seeding year. When sown without a nurse and in drills, the ley should be hoed several times during the first summer with a hand or horse hoe, and if necessary hand weeded also. In the first harvest year hoeing should be started as early in the spring as the condition of the soil permits, and if necessary hand hoeing should be resorted to and the process be repeated after the first cut, and if need be, again after the second cut. These hoeings are doubly important in regions of high rainfall (a necessity which affords a strong argument for sowing lucerne in drills in such situations) where weeds grow rapidly, and generally where the conditions are not particularly favourable to lucerne. Harrowing as a means of keeping down weeds is not to be recommended until after the first harvest year as there is too great a risk of injuring the young plants.

Subsequent to the first harvest year, harrowing or other methods of cultivation should be resorted to with a view to keeping down weeds. As to whether harrowing is beneficial, apart from weed destruction, is doubtful, and it is not recommended by Oakley and Westover on broadcast leys, neither is it considered to be a sound practice under South African conditions.* Harrowing is recommended by Witte and Elofson in the second and subsequent harvest years (when the leys have been drilled) and should probably be regarded as an important operation under high rainfall conditions in this country, both with a view to the suppression of weeds (especially bent and other grasses), and the breaking of the consolidated soil surface and consequent aeration. If the soil is not in a suitable condition when the lucerne is commencing active growth in the spring Witte recommends harrowing immediately (within two days) after the first cutting, and if possible again after the last cut of the season.

Suitable implements must be used, and the tines of the harrow should not be too sharp. Oakley and Westover state that experience has shown that in most cases the use of the disc harrow is actually injurious and that this or any implement that tends to split the crowns should be avoided.

* See Reid, V. D.: "Lucerne Growing in Vincent County," New Zealand Journal of Agriculture, Vol. XXVI, 1923, p. 219.

Practice with reference to the treatment of the crop and utilisation of the produce during the seeding year is varied in the extreme. Experiments in Sweden indicate that under the conditions there obtaining it is best not to cut during the seeding year; if, however, the seeding has been early and the plant is in or near flowering stage, a cut can be sometimes taken at the end of August or early in September. In the Southern States of America, where lucerne grows rapidly from spring sowing, it is often possible and advantageous to take two or even three hay cuts during the seeding year. It is sometimes a common practice to cut over the leys in the seeding year once or even twice whilst still young, with the intention of keeping down the weeds and encouraging the young plants to "stool out." Work recently conducted by McKee,* however, seems to suggest that clipping has the reverse of beneficial influences on the young lucerne plants, resulting in a reduction of root system and loss of vigour during the subsequent (first harvest) year and it would appear that in no case (even despite excessive weediness) should a cut be made until the plants are coming into flower.

When fields are not cut during the growing season of the seeding year, various practices obtain for dealing with the dead growth which will be apparent during late autumn and early winter. Witte states that the dry stems should be raked together early in the spring, and in the Northern States of America, where the hardy variegated lucernes are grown, the fields are sometimes burned over early in the spring. In the dry Vincent country in New Zealand the stand is not infrequently cut when 5 in. to 6 in. high and the growth and weeds left on the ground to act as a mulch during the winter.†

In the second and subsequent harvest years lucerne is most usually cut two, three or even four times for hay or green fodder. Frequent cutting, however, has the effect of diminishing the persistency of the ley, and even under the most favourable conditions more than three cuts will tend in this direction, while under conditions less suited to lucerne cultivation it is not advisable to cut more than twice per season if it is desired to maintain a long duration ley.

The heaviest yields will be obtained from cuttings made when the crop is in full bloom, and, particularly on young leys, cutting

* See McKee, Roland, "The Effect of Clipping on the Root Development of Alfalfa," Jour. Amer. Soc. Agronomy, Vol. 8, 1916, p. 329. Investigations in progress at Aberystwyth with cocksfoot and other grasses show that repeated cutting has a very detrimental influence on the root development of plants so treated.

† See Reid, *loc. cit.*

too late or too early has equally bad effects on persistency and is not to be recommended; in particular cutting before flowering time is fatal to persistency. As a rule the crop should be cut when about one-third and not more than one-half of the stand is in flower, a procedure which is compatible with the saving of fodder of high nutritive value, and with safeguarding persistency.

Although lucerne is essentially a hay and soiling crop, as previously stated, it is used to a considerable extent as pasturage in many parts of the world. It is generally recommended that lucerne should not be grazed in the first harvest year, and it is an established fact that it should not be grazed continuously or allowed to be eaten down to the crowns.

Lucerne in Mixtures.—Grasses and clovers may be sown together with lucerne for one of two purposes:—either to add to the keep during the seeding and first harvest year only, and to suppress weeds during that period, or to grow with the lucerne during the whole period of the ley. Lucerne is sometimes used as an ingredient in ordinary mixtures intended for long duration leys.

Ordinary Mixtures.—Lucerne in amounts varying from 3 lb. to 10 lb. per acre is often included in mixtures of the Elliot type, and frequently justifies itself on chalky and gravelly soils. Its inclusion in such mixtures regardless of soil and other conditions is, however, from the point of view of its contribution to the hay crop, in many cases merely a waste of seed. A mixture consisting of tall oat grass 5 lb., Vale of Clwyd red clover 7½ lb., and lucerne 15 lb. per acre, was sown in 1922 at Aberystwyth. The lucerne braided fairly well, but never looked healthy during the seeding year, and in the first hay crop (1923) only contributed 0.42 per cent. to the total produce. In general, it may be said that the lucerne in ordinary mixtures sown under non-lucerne conditions will do less well than if sown alone. Elofson with considerable justice none the less advocates the inclusion of lucerne in ordinary mixtures, simply as an index plant, to ascertain whether lucerne succeeds on particular fields and in particular districts, and, if succeeding, by degrees to increase the nitrogen bacteria. Where appreciable contributions result pure lucerne leys should be subsequently tried.

The Addition of Grasses or Clovers to suppress Weeds during the Seeding and First Harvest Years of a Lucerne Ley.—With this end in view short lived grasses or clovers are usually employed, and as the result of trials conducted by Lindhard in

Denmark it would seem that the contribution of the short lived species should be but slight and that of the lucerne considerable.*

Broad red clover (successfully employed at Saxmundham), Italian rye grass, and quite small sowings of tall oat grass, have been employed, while in this country trefoil is sometimes used, and small sowings of wild white clover have been tried.

There is always some risk of the quick growing plants sown competing adversely with the lucerne as effectively as would weeds—it would therefore seem desirable to rely on hoeing when the lucerne is drilled and only to include small amounts of a quick growing species when lucerne is broadcast on a field known to have been insufficiently cleaned.

Lucerne-Grass Leys in Place of Pure Lucerne.—Under certain conditions a lucerne-grass ley may be more profitable than a pure lucerne stand, and in any event has certain advantages to recommend it. The various operations connected with hay-making can be carried out more easily—an important consideration in regions of rather high rainfall. The ration is more varied, which is an advantage for certain purposes. In addition, weeds may to some extent be suppressed, and such leys generally establish themselves when broadcast better than pure lucerne; the necessity for hoeing and cultivation is thus obviated, and in certain localities the crops are somewhat heavier.

A lucerne-grass ley can with advantage replace a late-flowering red clover-grass ley intended for, say, three years, on soils which are too dry to carry good crops of red clover. For land where it can be shown that a lucerne-grass ley gives a greater bulk of forage than pure lucerne over a long period of years there is of course much to be said in favour of the combination. Soils rich in humus are best suited to long duration lucerne-grass leys, which would not seem to be well adapted to very dry soils, or to regions of particularly low rainfall.

It is probably best to combine but a single grass with lucerne. The species chosen should be persistent under meadow conditions, should recover rapidly after cutting, and yield two good cuts a year, while it should also come into flower at about the same time as the lucerne. Timothy is somewhat largely employed for this purpose in America, but can hardly be regarded as a very suitable species in England, since it flowers too late and does not recover particularly well after cutting. Witte refers to interesting trials conducted at Alnarp (by Forsberg) and at

* Lindhard. E., "Forsøg med Kaellingetand og i Lucerne Graesblanding," Tystofte, 1910-13.

Svalöf, which indicate that cocksfoot and tall oat grass are perhaps the best grasses for the purpose—a combination of lucerne with each having given higher yields over a six-year period (1915-20) at Alnarp and in the first harvest year (1920) at Svalöf than pure lucerne. The following relative statement taken from Witte shows the state of affairs at Alnarp* :—

Lucerne alone	...	100.0	} Based on total produce for the six-year period.
Lucerne and cocksfoot	...	132.4	
Lucerne and tall oat grass	...	138.3	

Other Swedish trials also indicate that tall oat grass with lucerne gives on the average slightly heavier yields than cocksfoot. Cocksfoot, however, gives a more leafy hay than tall oat grass and also stands grazing better, and in this country is likely to give the better results. Before the era of the motor lorry, market gardeners in parts of Kent used to grow cocksfoot-lucerne leys for their horses, and the writer has seen excellent examples of these near Greenhithe from which heavy hay crops were taken twice a year, while Oldershaw quotes a case of a lucerne-cocksfoot ley which has given excellent results over a nine-year period.†

The mixtures employed in Sweden have varied from $2\frac{1}{2}$ to 7 lb. of cocksfoot—about $4\frac{1}{2}$ lb. having apparently given the best results—with 18 to 27 lb. of lucerne per acre. Tall oat grass is generally employed at the rate of 7 to $10\frac{1}{2}$ lb. in mixtures with lucerne.‡ Were it not for the high price of the seed golden oat grass would probably also be a good species to employ in conjunction with lucerne.

The Improvement of Lucerne.—It is beyond the scope of this article to enter into details with reference to breeding lucerne, but there are certain considerations that should be of interest to the general reader. It must be remembered in the first place that the variegated lucernes of commerce are all natural hybrids, and that they have not been bred carefully from segregates obviously suited, after selection, for particular districts. Thus, even supposing that Grimm or other commercial varieties of the natural hybrids were proved to be no gain on Provence for any one of the varied habitats obtaining in Britain—this would not be evidence that it would be impossible or even difficult to breed a hybrid lucerne of extreme value for some of our more difficult habitats.

* See Witte ".....i Nordamerika," *loc. cit.*

† Oldershaw, A. W., "Lucerne and its many good Qualities," *Modern Farming*, July, 1920.

‡ Trials at Aberystwyth of Tall Oat Grass with Red Clover have also shown that this grass needs to be sown in larger amounts than Cocksfoot.

Such selection as has so far been operative on the commercial lucernes has been in favour of drought resistance and frost resistance, neither of which is of supreme importance, except perhaps in restricted areas, in Britain. The case for the prosecution of critical breeding work with lucerne in this country is based not only on the great value of the crop but on the almost accidental success of the variegated types in North America, and on the fact that lucerne, almost alone of the herbage and forage legumes and grasses, appears to be an ideal species for the plant breeder. The technique of fertilization is simple, and, given the necessary mechanical assistance, it is a self-fertile plant.*

Summary and Conclusions.—1. It is evident from a review of the literature cited in this paper that lucerne is a crop of exceptional importance, and judging by the scant reference to it in the agricultural literature of this country it would appear to be equally evident that not enough attention has been given to the possibilities of increasing the area under lucerne in Britain.

2. It is not to be supposed that lucerne could be successfully grown in all districts, or on every farm in particular districts, but having in mind its great value, especially in years of drought, it would be to the interest of most stock farmers to endeavour to maintain at least a small area of lucerne on their holdings.

3. Investigation is necessary in the direction of thoroughly testing the most promising nationalities and strains over the widest possible area in the country. Hungarian lucerne, with Grimm and other representatives of the variegated lucerne should be tried against Provence. These trials should be followed up by

* The following papers may be cited as amongst those which give the most useful information relative to Lucerne breeding :—

Southworth, W.—"Alfalfa Hybridization," Scientific Agriculture (Canada), Vol. II, 1922, p. 257, and Journal of Heredity, Vol. V (10), October, 1914.

Oliver, G. W.—"New Methods of Plant Breeding," United States Department of Agriculture, Bureau of Plant Industry, Bull. 167, 1910.

Piper, C. V.—"Alfalfa Seed Production: Pollination Studies," United States Department of Agriculture, Bureau of Plant Industry, Bull. 75, 1914

Witte, Harnfrid—"Alfalfa Breeding: Its Possibilities and Purposes in Sweden and some Observations concerning different Characters in the Crossing between the Blue-Flowered Alfalfa (*Medicago sativa*) and the Yellow-Flowered (*M. falcata*)." (Summary in English), in Sveriges Utsädesförenings Tidskrift, Häfte V, 1921.

Waldron, L. R.—"Cross-Fertilization in Alfalfa," Journal American Society of Agronomy, Vol. XI, 1919, p. 259.

"First Generation Crosses between two Alfalfa Species," *ibid.*, Vol. XII, 1920, p. 133.

research with a view to breeding improved strains suitable to those areas where it is at present difficult or impossible to grow the crop with reasonable success.

4. Cultural methods need also to be made the subject of exhaustive and careful investigation, of particular importance being the question of the rival claims of broadcasting, drilling and growing in spaced rows, under different conditions of soil and climate.

5. Equally important is the question of the best and most economic means of inoculation, and the relation of applications of lime and of manurial dressings to yield as such and to the necessity for or efficiency of inoculation under varied conditions.

* * * * *

FEEDING TRIALS WITH SILAGE.

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IN 1920, Mr. A. H. Chaytor, M.A., of Hurst Green, Sussex, presented a tower silo (Fig. 1) to the College for experimental purposes, and during the years 1921-22 and 1922-23 trials have been carried out which were designed to obtain information regarding the economic value of silage. In both years the silage was tried against roots. All the foods used were analysed and, with the exception of the silage, their compositions were sufficiently near to the average figures in the tables published by the Ministry,* for the latter to be used in compounding the rations. In the case of the silage the rations were based on the actual analyses.†

The Composition of Oat and Tare Silage.—The analysis of oat and tare silage was found to vary considerably, not only from year to year, but in samples taken at different heights in the silo. During the years under discussion it was very noticeable that the composition of a crop of oats and tares at the time of cutting depends principally upon the weather during growth. In the year 1920-21 the early part of the summer was dry and the tares made poor growth, the proportion of tares at the time of cutting being small, but in the year 1921-22 when the weather

* See tables in the Ministry's Miscellaneous Publication No. 32, "Rations for Farm Stock."

† The digestible constituents were calculated by the use of the co-efficients of digestibility determined by Wood and Woodman (Jour. Agr. Sci., July, 1921).

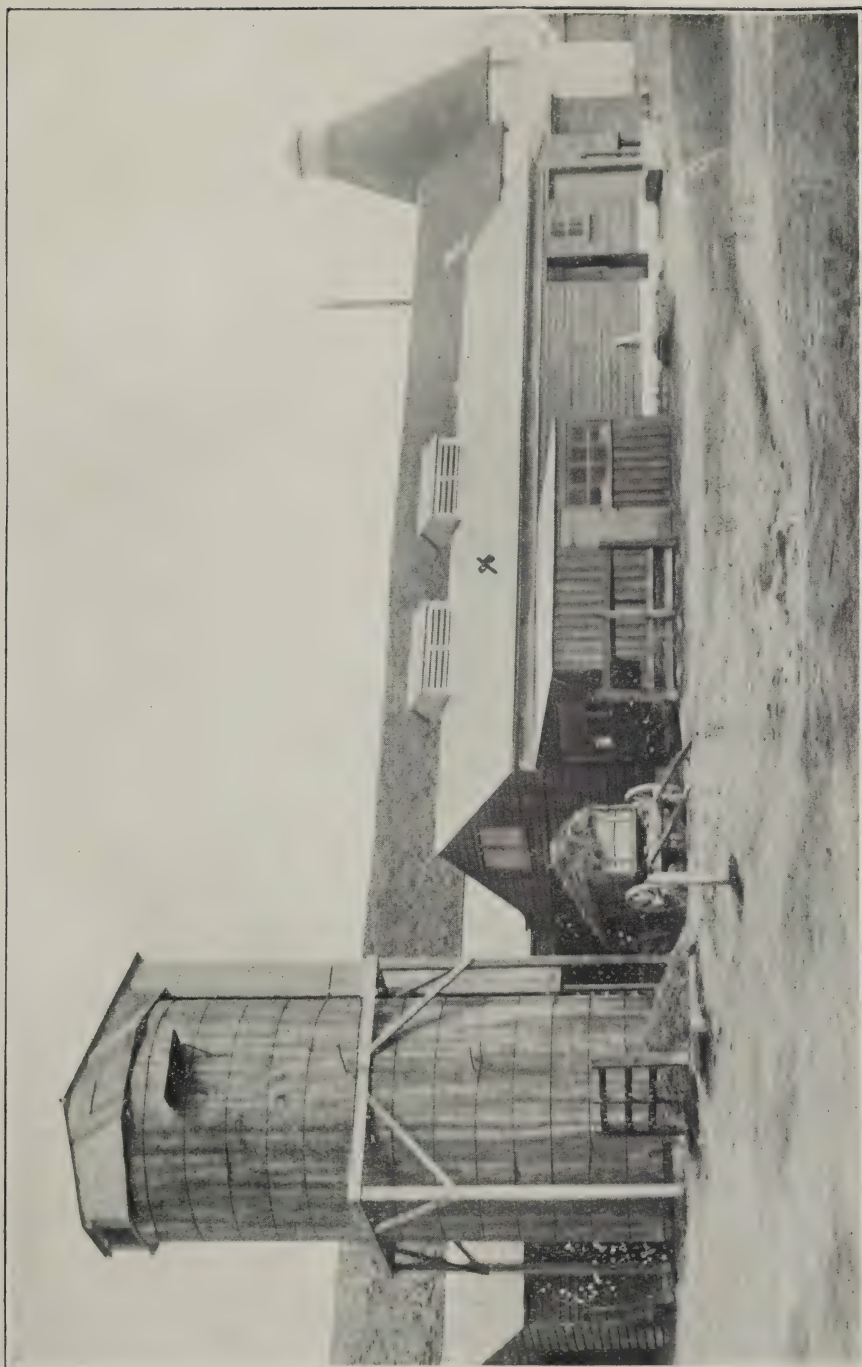


FIG. 1.—Farm Buildings at Wye, showing the Silo and the Cow-house.

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was showery the tares grew vigorously and formed the bulk of the crop. The quality of silage is dependent partly upon the kind of green material put into the silo and partly upon its condition,* the latter being governed very largely by the weather at the time of cutting. It will be readily understood therefore that the composition of oat and tare silage is very variable, and if it is to be used to the best advantage, rations must be based on actual analysis.

Density of Oat and Tare Silage.—Numerous inquiries have been received regarding the capacity of silos and weight of silage. The College silo is 14 feet in diameter and 32 feet high. In 1920-21 it contained 24 feet of usable silage after it had settled, weighing† 67 tons; that is to say, about 55 cubic feet of silage weighed 1 ton. In 1921-22 there were 21 feet of usable silage weighing 59 tons; that is, 54 cubic feet weighed 1 ton.

Costs.—The cost of the production of silage used in the succeeding pages includes all expenses incurred in growing, harvesting and storing the green material, but does not include the cost of removing the silage from the silo and of feeding. The cost of roots includes all the expenses up to the time they arrive in the root store, which adjoins the mixing room, but does not include the cost of cutting and feeding. The method of dealing with the silage at Wye is as follows:—A trolley is placed under the shoot so that the silage as it is thrown out of the silo falls into the trolley. Two men are employed, one in the silo throwing the silage down the shoot, and one packing it into the trolley and wheeling it away. The silo adjoins the buildings (Fig. 1). It is about 20 yards from the silo to the food store. With regard to the roots two men are employed to cut them, one to fill the cutter and the other to remove the cut roots. The cutter is driven by an engine.

In 1922-23 the above operations were timed and the following notes were made:—

1. It was found to take about twice as long to cut the roots for a number of cows as it did to bring the silage for them from the silo.

2. The cost of running the engine was saved in the case of the silage.

* Amos and Williams, Jour. Agr. Science, Vol. XII, Pt. 4.

† The weight was ascertained by keeping a record of the number of trolley loads taken from the silo, a trolley load being weighed periodically.

3. The weight which had to be distributed amongst the cows was less with the silage ration than with the root ration. With a small head of stock, such as was employed in these trials, it is impossible to estimate with any degree of accuracy the amount of time saved by using silage instead of roots, but from the observations made it is evident that in the case of a large head of stock the saving in this direction would be considerable. This should be borne in mind in considering the figures regarding cost given in the subsequent pages.

Soil and Climate.—The crops described in this paper were grown upon a light working clay soil overlying the chalk, which in places is only a few feet below the surface. The rainfall of the district is low, about 30 inches per annum.

Feeding Trial with Dairy Cows in 1921-22.—The 1920-21 crop was sown on 25th February at the rate of $2\frac{1}{2}$ bushels of tares and $1\frac{1}{2}$ bushels of oats. It was manured with 6 cwt. of slag (30 per cent.), 4 cwt. of kainit, and 1 cwt. of sulphate of ammonia. It was cut on 4th July in hot weather, and was allowed to lie in the swath for about 12 hours to wilt before being carted. The tares did not grow well, and at the time of cutting tares and oats were in about equal proportions. The tares were in full flower and the oats had reached the milk stage. It was not possible to take any weights, but the crop was estimated, by eye, to be about 8 tons of green material per acre.

The silage when removed from the silo was brownish in colour, had a pleasant smell, and was readily eaten by all kinds of horned stock. The quantity of usable silage (67 tons) is equivalent to 6 tons per acre. After the silage crop had been harvested the land was ploughed and sown with turnips and rape, but these failed owing to the dry weather. In this year swedes failed and mangolds yielded $15\frac{1}{2}$ tons per acre.

Rations.*—Each cow received a basal ration, which was arranged to provide sufficient nutrient materials for the maintenance of the cow† and to enable her to produce her calf. It consisted of :—

<i>When on Silage.</i>	<i>When on Mangolds.</i>
3 lb. Straw.	9 lb. Straw.
6 „ Hay.	8 „ Hay.
45 „ Silage.	56 „ Mangolds.

and in addition to the above 2 lb. oats, 1 lb. Egyptian cotton

* These were compounded on the lines laid down in Leaflet No. 388, the dry matter content being checked by the curves given in Miscellaneous Publication No. 32.

† Average weight, 10 cwt.

cake and 1 lb. linseed cake were fed for each gallon of milk yielded.

Only six cows were available for this trial. They were divided into two groups—A and B—with 3 cows in each group, the cows being matched as nearly as possible as regards age, lactation period, and size. The rations were weighed out each day. The milk was weighed as it was drawn from the cows. The cows were fed as follows:—

			Period.	Group A. Group B.	
Preliminary period	...	...	Jan. 9 to Jan. 22.	...	Roots. Silage.
1st Trial period	...	...	Jan. 23., Feb. 27.	...	" "
			Feb. 28., Mar. 12.	...	Foods changed.
2nd Trial period	...	...	Mar. 13., Apl. 16.	...	Silage. Roots.

The milk yields were:—

			Silage.	Roots.	
			lb.	lb.	
1st period	...	...	Group B: 3,372	...	Group A: 3,360
2nd period	...	...	" A: 3,368	...	" B: 3,386
Total			6,740	...	6,746

*Costs.**—The cost of silage was £2 7s. 6d. per ton and that of the mangolds £1 7s., and on this basis the cost of the food consumed to produce 1 gallon of milk was the same with both the mangold and the silage rations, viz., 10d. In considering the question of costs, it should be borne in mind (1) That in 1921 in this district both cabbages and swedes were a failure; (2) Silage was the only succulent food available in any quantity between September and Christmas; and (3) The price of £1 7s. was the actual cost of producing the mangold crop, but in order to get a fair comparison between silage and roots the mangolds should be charged at the average price of producing a ton of roots (*i.e.* average of swedes and mangolds), which was about £2 10s. as the swede crop was a failure. If the roots used are charged at £2 10s. per ton, the cost of producing a gallon of milk comes to 1s. per gallon.

Feeding Trials with Dairy Cows in 1922-23.—The seed for the 1921-22 crop was drilled on 29th October at the rate of $2\frac{1}{4}$ bushels of tares and 1 bushel of oats. Six cwt. slag (30 per cent.), and 4 cwt. of kainit were applied to the land before sowing, and 1 cwt. of sulphate of ammonia was applied as a top dressing in the spring. The crop was cut and carted between

* Hay was valued at £5 per ton, straw at 50s. per ton, oats at 35s. per qr., Linseed cake £14 15s. per ton, Egyptian cotton cake £9 5s. per ton. The cost of silage and roots were ascertained by H. W. Kersey on the lines laid down by C. S. Orwin in his book on Farm Costings, and in considering these it should be remembered that wages have fallen since 1922.

16th and 22nd June in showery weather. It was allowed to lie in the swath for about 24 hours before carting, but did not dry much. The material which was put into the bottom of the silo was wet with rain which fell just before and during carting. The oats had not made much growth, and the crop consisted mainly of tares, which were in full flower at the time of cutting. The weight of freshly cut green material was estimated to be 7 tons 6 cwt. per acre.

The silage was a dark greenish brown, almost black, colour, with a very distinctive smell; that from the upper part of the silo was quite palatable, but at the bottom where the green material was carted when wet with rain the silage was darker in colour, had a more pronounced smell and was eaten with less relish than that from the upper portion. The weight of usable silage taken from the silo (59 tons) is equal to a yield of nearly 5 tons per acre.

After the silage crop had been removed the land was ploughed and sown with white turnips, which yielded 15 tons per acre. In this year swedes yielded 20 tons per acre and mangolds about 24½ tons.

Rations.—The basic ration was arranged to provide sufficient nutrient material for the maintenance of the cow* and to enable her to produce 1 gallon of milk per day in addition to her calf's needs. It consisted at the commencement of the trial of:—

When on Silage.

6 lb. Straw.
8 „ Hay.
45 „ Silage.

When on Mangolds.

6 lb. Straw.
12 „ Hay.
84 „ Mangolds.
2 „ Egyptian cotton cake.

and in addition to the above each cow received 2 lb. of oats, 1 lb. of Egyptian cotton cake and 1 lb. of linseed cake *for each gallon of milk yielded in excess of 1 gallon.*

The silage from the bottom of the silo proved to be of poorer quality than that from the upper portion and, at the end of April, it was necessary to add 2 lb. of Egyptian cotton cake to the silage ration to bring the protein up to the theoretical standard.

Eight cows were available for this trial and these were divided into two groups—C and D—with four cows in each group. During the first change period Number 13 (in Group D) had an attack of indigestion and her milk yield was abnormal for about a fortnight.

* Average weight 11 cwt.

Rations were weighed out each day. The milk was weighed as it was drawn from the cows. The cows were fed as under:—

		1923.		Group C.	Group D.
Preliminary period	...	Jan. 22 to Jan. 29	...	Mangolds.	Silage.
1st Trial period	...	Jan. 30 „ Feb. 19	...	„	„
		Feb. 20 „ Feb. 26	...	Food changed.	
2nd Trial period	...	Feb. 27 „ Mar. 19	...	Silage.	Mangolds.
		Mar. 20 „ Mar. 26	...	Food changed.	
3rd Trial period	...	Mar. 27 „ Apl. 16	...	Mangolds.	Silage.
		Apl. 17 „ Apl. 23	...	Food changed.	
4th Trial period	...	Apl. 24 „ May 15	...	Silage.	Mangolds.

The milk yields were:—

			Silage.			Mangolds.
			lb.			lb.
1st period	...	...	Group D : 2,943 $\frac{1}{2}$	...	Group C :	2,806 $\frac{1}{2}$
2nd period	...	...	„ C : 2,507 $\frac{3}{4}$	...	„ D :	2,876 $\frac{1}{4}$
3rd period	...	...	„ D : 2,750 $\frac{1}{2}$	...	„ C :	2,572 $\frac{3}{4}$
4th period	...	...	„ C : 2,372 $\frac{3}{4}$	...	„ D :	2,920 $\frac{3}{4}$
			Total	10,574 $\frac{1}{2}$	...	11,176 $\frac{1}{4}$

showing a difference in favour of the mangold ration of about 60 gallons (5 per cent.).

The difference in the milk yields was undoubtedly to a certain extent accounted for by the deterioration which took place in the quality of the silage during the trial. In the earlier part of the winter the silage improved in quality the lower it came from in the silo, and in framing the rations after Christmas, allowance was made for a further improvement. The material at the bottom of the silo, however, proved to be of poorer quality.

*Costs.**—The cost of production of the silage was £2 10s. per ton and that of the mangolds 15s. 8d. per ton. On this basis the food used to produce 1 gallon of milk cost 8 $\frac{3}{4}$ d. with the silage ration, and 8d. with the mangold ration.

Quality of Milk.—The opinion is held by some feeders that silage will taint the milk of cows to which it is fed. This opinion has not been confirmed at Wye. On no occasion has any bad flavour been noticed and during the time the 1922-23 trial was being carried out the College herd was included in the Kent Clean Milk competition, in which it was placed second. Whilst the competition was in progress the milk was examined periodically by a dairy expert. Fig. 1 shows the arrangement of the buildings: it will be noticed that the silo is only separated from the cowshed by about 5 yards.

* Hay was valued at £5 per ton, straw at 30s., linseed cake at £14, undecorticated cotton cake at £8 5s. and oats at £10.

The fat content was taken regularly during the two trials described in this paper, and the records do not indicate that the change from roots to silage or vice versa had any definite effect upon the quality of the milk.

A Feeding Trial with Fattening Bullocks.—This trial was commenced on 6th November, 1922, and finished on 8th March, 1923. The silage used was from the 1921-22 crop described above. It came from the upper part of the silo and improved slightly in quality during the trial. Fourteen two-year-old bullocks were available. They were put up to fatten on 26th October in two groups, A and B. The animals in Group A were fed upon a ration containing silage, those in Group B upon a similar ration which contained swedes instead of silage. The beasts were fed in a covered yard in which they lay loose, Group B occupying three small bays and Group A lying in one lot in the large yard. The rations were weighed daily. A preliminary period of 10 days was allowed for beasts to get used to yard feeding, and the trial then started on 6th November.

At the commencement of feeding the rations per head per day were :—

<i>Group A.</i>	<i>Group B.</i>
12 lb. Oat straw.	12 lb. Oat straw.
50 „ Silage.	70 „ Swedes.
4 „ Egyptian cotton cake.	4 „ Egyptian cotton cake.
2 „ Linseed cake.	2 „ Linseed cake.
2½ „ Wheat meal.	

The allowance of concentrates for Group A was increased on 14th November by an additional ½ lb. of wheat meal, and on 3rd December 2 lb. of wheat meal were added to both rations. At this date the bullocks getting silage were eating only 7 lb. of straw. On 14th December the allowance of swedes in the ration of Group B was raised to 84 lb. but as the silage had improved in quality the ration of Group A was not increased, the rations from this date to the end of the trial being :—

<i>Group A.</i>	<i>Group B.</i>
7 lb. Straw.	12 lb. Straw.
50 „ Silage.	84 „ Swedes.
4 „ Egyptian cotton cake.	4 „ Egyptian cotton cake.
2 „ Linseed cake.	2 „ Linseed cake.
5 „ Meal.*	2 „ Meal.*

The experiment finished on 8th March when there was no noticeable difference in condition between the two groups. The

* Wheat meal until 1st Jan. ; after that date barley meal.

average weights of the bullocks were :—

		<i>Average Weight</i> <i>at Start.</i>		<i>Finished Weight.</i>		<i>Gain.</i>	
		cwt.	lb.	cwt.	lb.	cwt.	lb.
Group A ...	...	8	18	10	47	2	29
Group B ...	...	8	27	10	25	1	110

The average daily gain per head in Group A was 2.1 lb. and in Group B 1.9 lb.

*Costs.**—With silage costing £2 10s. per ton and roots 15s. 8d. the cost of food was £94 9s. 5d. for Group A and £59 16s. 8d. in the case of Group B. The cost per 1 lb. live weight increase was—

1s. 0 $\frac{3}{4}$ d. in the case of bullocks getting silage, and
9 $\frac{1}{4}$ d. in the case of those getting roots.

The carcasses were carefully examined, no difference being detected either in appearance, the amount of internal fat, or the flavour of the meat, in the two groups.

Thanks are due to Captain E. T. Halnan and Mr. Arthur Amos for their help in drawing up the scheme of experiments.

Conclusions.—(1) Oat and tare silage has been shown to be a satisfactory substitute for roots in the ration of dairy cows. When silage was used less coarse fodder was required, and in 1922-23 a saving was effected in the concentrates.

(2) In 1921-22 the cost of food required to produce 1 gallon of milk was the same with both the silage and the mangold rations if the latter were not saddled with the loss on the swede crop which failed. In 1922-23 the mangolds were slightly the cheaper food.

(3) In the one trial that was carried out with fattening bullocks silage was found to be a suitable food, but more expensive for fattening than swedes.

(4) The quality of both milk and beef produced by cattle fed upon silage was as good as that produced by root-fed stock.

(5) The great value of silage would appear to lie in the fact that crops suitable for making into silage are much more certain than roots. The silage crop being sown in the autumn or early spring will almost invariably produce something even in districts where roots often fail completely.

* Straw valued at 30s. per ton, undecorticated cotton cake at £8 5s., linseed cake at £14, wheat and barley meal at £12.

(6) Silage is very variable in composition. Rations should therefore be based on an actual analysis.

(7) In a silo 14 feet in diameter and 32 feet high the number of cubic feet to the ton was 55 in 1921 and 53 in 1922.

* * * * *

COUNCIL OF AGRICULTURE FOR ENGLAND.

THE Twelfth Meeting of the Council of Agriculture for England was held on Friday, 22nd February, 1924, at the Middlesex Guildhall, Westminster.

Appointment to Agricultural Advisory Committee for England and Wales.—Before the meeting of the full Council, a meeting of the members thereof representing County and Borough Agricultural Committees was held for the purpose of making an appointment from its number to the Agricultural Advisory Committee in view of the vacancy which existed. The election of Mr. Harry German was moved, seconded and agreed.

Meeting of Council.—The first business of the Council was to elect a Chairman for the year 1924. On the motion of Mr. Ryland, seconded by Mr. Harry German, Mr. George Edwards, M.P., was elected to the Chair. In the course of a short address, Mr. Edwards said he esteemed most highly the honour which had been conferred upon him, and he was sure that all present were anxious to do the very best they could towards putting the industry on a firmer and more prosperous footing than was the case at present.

Death of Council Members.—Lord Bledisloe proposed and Mr. Hamilton seconded a motion recording the deep regret of the Council on learning of the death of their colleague, Mr. Fitz-herbert Brockholes. Mr. Robbins proposed a similar vote in respect of the death of the Earl of Jersey, which was seconded by Mr. E. W. Lobjoit. The Council, standing, passed both votes.

Report of Proceedings of Agricultural Advisory Committee.—The Half-Yearly Report (No. 6) was received by the Council on the motion of Mr. E. W. Langford, seconded by Mr. G. G. Rea.

The Minister of Agriculture, the Rt. Hon. Noel Buxton, M.P., in the course of his address, said he appreciated very much the invitation to meet the Council, and he was glad to see the comprehensive agenda for the meeting, which indicated the active part which a large number of members took in the proceedings.

He referred to the situation in regard to foot-and-mouth disease, and said that a Committee to consider the administrative problems in regard to the disease had been set up, with the Rt. Hon. E. G. Pretyma as Chairman, and that another Committee to consider the aspect of scientific research in regard to the disease was about to be set up under the Chairmanship of Sir Charles Sherrington, President of the Royal Society. He said that he sympathised deeply with those who had been placed in an extraordinarily difficult position by the outbreak. The scheme established by the Agricultural Credits Act of last year would be a means of helping those who are in want of capital for re-stocking their farms, in a way that had not been possible before. He had been able to arrange with the Chancellor of the Exchequer for a reduction of 1 per cent. in the rate at which loans could be made, which meant that loans should be available through Agricultural Credit Societies to individual farmers at 5 per cent., instead of 6 per cent. as at the present time. With regard to co-operation, the Chancellor of the Exchequer had agreed to the inclusion in the next year's Estimates of a sum of £200,000 for financing agricultural co-operative enterprises, with a limit for each society of £10,000. He hoped that these facilities would be widely employed. There would be further means provided under the Trade Facilities Act to encourage the formation of larger undertakings of a similar character.

With regard to live stock improvement, he was of opinion that the economy made a few years ago in regard to the grants to Heavy Horse Societies was not a useful one, and he had secured a reversal of the position, so that the grants would be continued in future.

With regard to land drainage work for the relief of unemployment, the grants given by the late Government at the beginning of the autumn would be increased by £60,000, so that schemes which had been held up through lack of funds could now go forward.

In conclusion, the Minister said he hoped that funds would be available to encourage the formation of Account-keeping Societies, somewhat on the lines of Milk Recording Societies, and to provide for the appointment of Marketing Advisory Officers as recommended in the Linlithgow Report. These were some of the ways in which the Government considered it could do good, and be of practical assistance to those engaged in agriculture. He would give the most earnest attention to any suggestions that came from the Council.

Sir Douglas Newton said that the Council appreciated the Minister's action in carrying on the tradition of the past and coming to the Council and stating frankly and fully what was in his mind. He asked as regards the £200,000 for co-operative enterprises whether it would be possible to add to that in the event of more money being required. He expressed the hope that special action would be taken in the development of co-operative marketing and in the grading and packing of fruit. Mr. Nicholls asked whether any special provision had been made in relation to putting the rent of smallholders, ex-Service smallholders, on an economic basis. Lord Bledisloe suggested, in connection with the motion which was on the agenda in the name of Mr. Spraggon as to legislation giving County Councils power to deal with reclamation and improvement of agricultural land, that there was, in his view, a real danger of the Government grant being to some extent wasted unless the County Councils had larger powers than they had at the present time. Mr. Ryland asked whether, with the exception of those matters which the Minister had outlined, the industry was to be left to be carried on on an economic basis, or whether other measures were contemplated. Mr. Dallas asked as to the allocation of the £60,000 for drainage.

The Minister replied that the £60,000 for drainage was in addition to grants already sanctioned, and it would be allocated to schemes deserving of help amongst those which had been turned down or left in abeyance through lack of funds. In regard to the £200,000 for co-operative enterprises, that sum should be sufficient to go on with; he would ask for a further grant if sufficient schemes were forthcoming to justify such a request. There would be opportunities under the Trade Facilities Act for larger undertakings. With regard to Mr. Ryland's question, he would be out of order, he thought, if he entered upon politics at large, and, as to others, he could not go into the subjects which would be raised on the agenda. With regard to all suggestions he would take careful note and consider them. Lord Clinton then moved a hearty vote of thanks to the Minister for his statement. This was seconded and carried unanimously.

Report of the Committee to consider in what manner the work of the Council might be made more profitable in the interests of Agriculture.—As Chairman of the Committee, Lord Clinton proposed the acceptance and adoption of the Report.* He said, in the course of his statement, that when the Selborne

Reconstruction Committee reported, they had visualised a body which would be of the first importance to the agricultural industry and would be of the greatest assistance to the country and Parliament.

It appeared to the Committee that there were two main reasons why the Council's work had not been more effective, and these were, first, that the number of meetings were insufficient, and secondly, that there was no body, or committee, which could arrange the Council's work and look after procedure. The Act of Parliament laid down certain regulations and provided the Council with a constitution. The main proposals in the Report were that the Council should meet at least four times a year, and that a Standing Committee should be formed with the duties which had been laid down briefly and generally in the Committee's Report. No doubt other duties would be found to come within the Standing Committee's work when it came to function. The Council might pass resolutions with which the Minister himself could not agree, as they might not fit in with the views of the Government. He considered that the Council should be able to present those views to Parliament in other ways than through the Minister, and for that purpose he thought it would probably be eventually necessary to set up a Parliamentary Committee for the purpose so that the Council could, through one or other of its members who are representatives in the Houses of Parliament, be able to put those views directly before Parliament. Mr. Dallas seconded the motion.

Mr. Robbins moved an amendment to Recommendation (A) of the Report, to omit the words "the Council shall meet at least four times a year instead of twice and that." He said that he was in favour of having as many meetings as necessary, but did not see that a good case had been made out for incurring the expense of bringing the Council together without sufficient business to transact. Major Courthope, Mr. Ryland, Mr. Turnor, Mr. Spraggon, Mr. Acland, Mr. Dallas, and other members joined in the discussion, in the course of which it was stated that the months fixed were those in which farmers and others interested could best get away from home, and that a minimum of four meetings a year, with the Standing Committee functioning, could not be excessive. Mr. Robbins' amendment was then put to the meeting and lost, and the Report was adopted by the Council.

Election of Standing Committee.—The question of the method of election of the Standing Committee was discussed, and it was suggested by Mr. White that a small Selection Committee should be appointed to facilitate the election. Mr. Beard seconded the proposal, which, after further discussion, was put to the meeting and lost. The Standing Committee elected were the following :—*Representatives of Land Owners* : The Rt. Hon. F. D. Acland, M.P., Sir Merrik Burrell, Bart., Major Fawkes, Sir Arthur Hazlerigg, Bart., and Sir Douglas Newton, M.P. *Representatives of Farmers* : Mr. R. Bruford, Mr. J. Donaldson, Mr. E. W. Lobjoit, Mr. R. G. Patterson, and Mr. Wm. Knight. *Representatives of Agricultural Workers* : Mr. A. W. Ashby, Mr. George Dallas, Lady Mabel Smith, Mr. R. Walker, and Mr. Denton Woodhead.

Fixing Rents for Small Holdings and Allotments.—Mr. James Hamilton moved :—

“That this Council recommends that in fixing the rents payable by ex-service men for Small Holdings and Allotments more consideration be given to the recommendations of County Committees.”

He said he did so on the assumption that the conditions of smallholders and allotment holders over the country were very much the same as in Lancashire. The Small Holdings Committee of that county had, last October, passed a resolution which pointed out that the depression prevailing in the agricultural industry at the present time was causing great distress, and that the burden carried by smallholders ought not to be aggravated by excessive rents. He said he understood that the Ministry of Agriculture, which had said that it did not consider the rents unduly high, was governed almost entirely by financial considerations, but he thought that the continuance of these men in their holdings was a more important matter than mere finance. Mr. E. W. Langford seconded the motion, which was discussed in the Council by Mr. George Nicholls, Mr. R. L. Walker, Lord Bledisloe, Mr. Royce, M.P., the Minister of Agriculture, Mr. Thomas, and Mr. Spraggon. The motion was then put to the meeting and lost.

Agricultural Workers and the Unemployment Acts.—Mr. Haman Porter moved :—

“That this Council being aware of the great hardship suffered by the Agricultural Workers of England through unemployment, is of opinion that the Agricultural Workers should be brought within the scope of the Unemployment Acts and respectfully asks His Majesty’s Government to take steps immediately to bring the Agricultural Workers of England within the scope of these Acts.”

Mr. Beard seconded. Mr. R. B. Walker said that agricultural workers had not been brought under the present Acts because they themselves had decided that they did not desire to come within it, and he suggested that some special scheme be evolved to meet the agricultural workers' case. Mr. Morris, Mr. Spraggon, Mr. W. R. Smith, M.P. (Parliamentary Secretary to the Ministry), Mr. Woodhead, Mr. Acland, Mr. Dallas, Mr. Rea, and Sir Douglas Newton also took part in the discussion. Mr. W. R. Smith said that, in his view, the question must be approached from the standpoint that agriculture does differ from other industries very materially, and that the payment of 10d. a week from the employer for each worker and 9d. from the worker himself as in other industries would probably be an impossible condition. At any rate, the Council might discuss the principle, and, if it endorsed it, leave the matter to the Ministry of Agriculture in conjunction with its advisers to work out a suitable scheme for agriculture. Mr. Ryland pointed out that the wages would have to be put up if the agricultural worker were brought under the Unemployment Insurance Acts with the ordinary contribution, so that, in effect, the whole of the money would really have to come from the farmer. His figures showed that a sum of about £2,350,000 would have to be found, which was unthinkable. Mr. Rea considered that the present unemployment, which was by no means general, had raised this question, but that it was almost entirely due to the present depressed condition of agriculture. That was the condition which should be remedied. If unemployment insurance were carried into effect, more people would be burdened than benefited. In the north of England unanimous opposition would probably be shown by the farm-workers themselves. Sir Douglas Newton suggested that the matter be referred to the Standing Committee for further careful consideration. Mr. Dallas seconded the motion, which was put to the meeting and carried.

Joint Animal Diseases Committee for each County.—Sir Merrik Burrell proposed:—

“That the Council is of opinion that legislation is urgently needed to provide that there shall be one authority only for the control of animal diseases in each geographical county, which should be a Joint Animal Diseases Committee representing the county and borough councils within the boundaries of each county.”

He said that Mr. Pretyma's Committee (in 1922) on foot-and-mouth disease had made strong recommendation for the action he now advocated. It would, however, require more than a

Departmental Order, it would need legislation. There were something like 266 different authorities in the country who can issue regulations regarding animal diseases, and this must lead to confusion. He thought that if the Council expressed a definite opinion on this matter it would strengthen the hands of the Minister of Agriculture in dealing with local opposition to the necessary legislation and also be of assistance to the Committee appointed to consider the administrative problems in regard to foot-and-mouth disease. Mr. German seconded this motion, which was put to the meeting and carried.

Animal Disease Research.—Mr. Dan Crawford moved :—

“That the Ministry be asked how much the Government is at present spending on research for agriculture ; also whether they are financially supporting the Rowett Research Institute, Aberdeen, and, if they are not, to propose that the Agricultural Research Council—or such other body as the Ministry think fit—make an inquiry to ascertain whether it would not be desirable for a capital sum and a certain amount per annum to be allocated to this Institute.”

He said that he had had an opportunity of visiting the Rowett Research Institution at Aberdeen and had never seen a place of the kind run on more economic lines. He would like to see it fully supported. Mr. E. W. Langford seconded the motion, stating that the work at the Rowett Institution would benefit more than Scotland. He wanted to see a better link between the scientists at the research stations and the farm institutes. It was one thing to test in a laboratory and another to apply the test to animals. Twelve or fifteen cows upon which to carry out experiments were not sufficient. More farm-buildings were required and a dairy of about 60 cows for ration tests, etc. The motion was also supported by Mr. Robbins. Mr. Dallas proposed that the following words should be added to the resolution :—

“That this Council recommends the Ministry of Agriculture, in co-operation with the Board of Agriculture for Scotland, to invite the Directors of the Animal Nutrition Research Institutes of Aberdeen and Cambridge to report upon the further facilities required for the purpose of research on animals in Great Britain, with special reference to the facilities required for large scale experiments.”

The addition was agreed to by the mover and seconder.

Sir Daniel Hall, K.C.B. (for the Ministry), said on the subject of research generally that there were three sources from which funds were at present derived: the Ministry's vote, the old Development Fund, and the new Development Fund of £850,000 under the Corn Production Acts (Repeal) Act. These funds provided at present about

£225,000 a year for agricultural research in England and Wales. There was also an expenditure of £264,000 on colleges for education, where a certain amount of investigation and research was being carried on. Scotland was autonomous in this class of research, and was therefore responsible for the State grants expended by the Rowett Institute. Sir Robert Greig had, however, informed him that the total capital expenditure of the Rowett Institute had been £51,000, of which £31,000 had been derived from the Board of Agriculture for Scotland, and that the total expenditure on maintenance up-to-date had been £26,000, all of which but £447 had come from public funds through that Board. As a matter of fact, further capital grants to the Institute were being considered. On the general question raised by Mr. Dallas, he thought that an informal discussion might very well take place between Professors Wood and Orr. Sir Douglas Newton appealed to the mover and seconder of the original resolution to withdraw it, which after further discussion they did on the understanding that Mr. Dallas's proposed addition should stand in its place. This was put to the Council and agreed.

Adequacy of Agricultural Education and Research.—Mr. Dallas moved :—

“That the Council should appoint a Committee to inquire into the adequacy of the existing facilities for agricultural education and research, and to report upon this matter, dealing at the same time with the allocation of the existing funds between agricultural education, research, and advisory work.”

He considered that the Council should have complete knowledge of everything that had been done by way of agricultural education and research and advisory work. Mr. Hawk seconded the proposal, which was supported by Mr. E. W. Langford and Mr. Denton Woodhead. It was agreed by the Council and referred to the Standing Committee for report.

Importation of Potatoes.—Mr. James Hamilton moved :—

“That in order to stabilise the price of potatoes, this Council recommends that in future potatoes shall not be imported except under licence given on the recommendation of the Potato Advisory Committee when in their opinion the wholesale price of home-grown potatoes is such as will cover the cost of production.”

Mr. Thomas seconded the motion, which was spoken to by Mr. Gardner, Mr. Dallas, Major Fawkes, and Mr. R. L. Walker. Major Fawkes asked whether the proposal would really stabilise prices at all or protect the public at all. After further discussion, Mr. R. L. Walker moved that the motion be deferred for

further consideration at the next meeting of the Council. This was seconded and agreed.

Adjournment of Council.—Mr. J. Forbes rose to move :—

“That the Council of Agriculture for England is of opinion that in cases where land has been purchased by local authorities for use as allotments, local authorities should not be permitted to sell or otherwise dispose of such land for any other purpose unless and until they have obtained the consent of the Ministry of Agriculture and Fisheries and the Ministry of Health to such sale or disposition.”

In the course of Mr. Forbes's speech, Mr. German inquired, on a point of order, whether a quorum of the Council was present. On a count being made, it was found that 41 members only were in the Council Chamber, and the quorum being 47, the Chairman declared the meeting adjourned.

The following is the Report of the Committee (signed on behalf of the Committee by Lord Clinton, Chairman) referred to on page 60 above :—

REPORT OF COMMITTEE APPOINTED 13TH DECEMBER, 1923.

1. A Committee of the Council was appointed at its meeting on the 13th December, 1923, to consider and report in what manner the work of the Council might be made more profitable in the interests of agriculture. The Committee has given careful consideration to this question, and recommend to the Council as follows :—

(A) That the Council shall meet at least four times a year instead of twice, and that special provision be made for calling emergency meetings at short notice.

(B) That a Standing Committee of the Council be set up with constitution, powers and functions as detailed below.

(C) That the Statutory Regulations made by the Minister of Agriculture and Fisheries under Section 5 (1) of the Ministry of Agriculture and Fisheries Act, 1919, should be altered, with the approval of Parliament, and the Standing Orders governing the Council's procedure be amended, to give effect to (a) and (b), and to make certain minor improvements in procedure.

2. In regard to (a), Statutory Regulation No. 3 (1) should be altered as follows so far as the Council of Agriculture for England is concerned—“The Council shall meet in December, March, May and October in each year on such date and at such place as the Minister, after consultation with the Chairman of the Council for the time being, shall direct. The Minister may, by notice in writing to the Secretary of the Council, require an additional or an emergency meeting to be convened whenever he thinks fit, and shall so require an additional or emergency meeting to be convened upon his receiving a request in writing to that effect, signed by the Chairman of the Council, acting with the authority of the Standing Committee of the Council set up under its Standing Orders, or by not less than 25 members of the Council.”

3. Regulation 3 (2) should be amended so far as the Council of Agriculture for England is concerned as follows :—"A meeting of the Council shall be convened by a notice in writing sent by the Secretary of the Council to each member of the Council 14 days at least before the date of meeting, but in the case of an emergency meeting for the discussion of a special matter or matters, it will be sufficient if 7 days' notice only be given."

4. In regard to (b) of the recommendations above, the Standing Committee should, we think, consist of 16 members, 5 to be owners of agricultural land, 5 to be tenants, and 5 to be representatives of workmen engaged in agriculture. The Chairman of the Council should be an ex-officio member of this Committee. In order to secure closer connection between the Council and the Agricultural Advisory Committee for England and Wales than exists at present, at least one of the five representatives in each of the three groups should also be members of the Agricultural Advisory Committee for England and Wales.

5. Five members of this Committee should form a quorum. The Committee should be elected at the meeting of the Council to be held on the 22nd February next, and re-elected annually at each December meeting of the Council.

6. The Standing Committee should normally meet once a month, with the exception possibly of August, September and January, and at such other times as the Chairman of the Committee may select. The Committee should elect its own Chairman and arrange its own procedure.

7. The duties of the Committee would be :—

(a) To keep watch on the agricultural position, and to bring before the Council matters of importance for the purpose of discussion by the Council.

(b) To keep in close touch with the Agricultural Advisory Committee for England and Wales, and to ascertain from time to time whether the Minister of Agriculture desires to set down for discussion by the Council one or more subjects on which he wishes to gather the authoritative opinion of agriculturists.

(c) To communicate with any state departments, or other bodies representing agricultural or rural interests, including the bodies concerned with research, education and organisation of those interests; and to invite them to submit their policies or other information for consideration by the Council.

(d) To prepare the Agenda for meetings of the Council, the items on which should be placed in the following order :—

1. Matters, if any, left over from previous meeting.
2. Statement by the Minister.
3. Reports of action taken by the Ministry of Agriculture in connection with previous resolutions of the Council.
4. Reports of Committees of the Council.
5. Discussions on any subjects suggested by the Minister.
6. Notices of motions from Standing Committee.
7. Notices of motions by members.
8. Any other business.

8. In addition to the suggested connection with the Agricultural Advisory Committee through the Standing Committee it would be of advantage that the

former Committee should present a report to the Council at each ordinary Council Meeting instead of half-yearly as at present.

9. The Secretary of the Council shall act as the Secretary of the Standing Committee, and all resolutions or communications connected with the Committee shall be addressed to him.

10. To give effect to the proposals under (A) above it will be necessary that the Minister of Agriculture be asked to amend the Statutory Regulations under Section 5 (1) of the Ministry of Agriculture and Fisheries Act, 1919, and that the amending Order be laid on the table of both Houses of Parliament.

11. To give effect to the proposals under (B) it will be sufficient if this report is adopted by the Council. It is suggested, however, that the Standing Orders of the Council might be amended in two minor respects as follows :—

(a) *Standing Order No. 3*: Amended to substitute "Standing Committee" for "Minister" as the authority to decide the order in which resolutions or motions shall appear on the Agenda.

(b) A new Standing Order authorising the Chairman to appoint tellers to assist him in the case of votings or elections by the Council.

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THE GLOUCESTERSHIRE FRUIT AND VEGETABLE CO-OPERATIVE MARKETING SOCIETY.

G. H. HOLLINGWORTH,

Agricultural Organiser for Gloucestershire.

THE idea of the above organisation really started at that period during the war when marketing societies were being formed in various counties for the purpose of disposing of surplus produce grown in gardens and on allotments, thus avoiding waste, and making the most of the food supply. These particular organisations could only be looked upon as war time emergencies, but the promoters of the Gloucestershire Society saw in the movement scope for the improvement of the methods of marketing the fruit and vegetables, eggs and poultry produced for profit in the county. It may be observed in passing that in several of the Western Counties it has long been the custom to sell a large proportion of the locally grown fruit and vegetables at the point of production by means of auction sales, instead of at the point of consumption, as is the case in other parts of the country. Generally, however, the market is controlled by some corporation or private auctioneer, and the well-known market at Pershore in Worcestershire was the first serious attempt at co-operation.

It so happened that at the time the Gloucestershire Society was formed the fruit growers and market gardeners in the Chelten-

ham district, where both fine fruit and high-class vegetables are grown, were dissatisfied with their local market, and much of the produce instead of passing through the market was sent away to be sold on commission. It took some time to persuade the Cheltenham Corporation that it would be better for the local industry and, incidentally, the ratepayers, to make a change, but this was at last effected and the Society, which was duly registered as a co-operative society, issued its prospectus on 17th July, 1919. In response to the appeal for capital nearly £5,000 was subscribed in £1 shares, largely by market growers, and a portion by county people who were interested in the movement. The Committee of Management were fortunate at the outset in securing the services of a thoroughly capable auctioneer, who with a manager and necessary staff is wholly employed in the business of the Society. That the movement was justified is proved by the fact that the gross turnover for the first six months trading in the Cheltenham Market was £38,954, or £20,000 more than the previous highest recorded annual turnover of the market.

Benefits of Co-operative Marketing.—It may be well to digress here and point to a few of the advantages to be derived through co-operative marketing. In the first place the market belongs to the producers who are shareholders, though non-shareholders also get the benefit of it, and is controlled by a committee of management representing the shareholders and appointed by them.

The produce is sold at the point of production, the grower sees it sold and is able to judge for himself whether the best is made of it. In short, he gets market price, be it bad, good or indifferent, according to supply and demand. The profits, if any, from the market do not go into the pocket of any outside person, but into that of the grower if he is a shareholder, in the form of interest on the capital he has subscribed and a bonus if the profits on the year's working justify this.

Above all there is the advantage of having a market close at hand in which the grower can dispose of his produce without any financial risk, because it should be understood that the grower always gets the money that his produce realises, less the commission for selling, and the Society takes the risk, which is by no means a small one, of doubtful buyers and bad debts. Indeed, all that is wanted to make a co-operative market a success is a spirit of true co-operation amongst the producers, a realisation that the market belongs to them individually and

collectively, and that it will stand or fall in accordance with the loyalty displayed by those who secure the advantages it offers. The problem of securing this true loyalty is one of the difficulties which promoters of co-operation have not yet been able fully to overcome, and the Society under notice is no exception to the rule.

Further Developments—Grange Court Market.—While the Cheltenham Market was growing in importance the eyes of the Management Committee of the Gloucestershire Society fell on another district, in the Vale of Severn, adjoining the Forest of Dean, which is singularly favoured by nature for growing fruit. This is the home of the Blaisdon Red Plum, a local variety which originated in the village which bears its name. Other good plums are produced in the locality, as well as apples, mostly grown by farmers and small occupiers whose only means of disposing of their fruit was to cart it a long way to a market, send it away on commission, or sell it to a local dealer.

Why not have a market in the heart of this favoured district? The idea was suggested to a few of the more enterprising of the local farmers, who immediately fell in with it. Further capital was raised and a market was opened at Grange Court, close to a junction on the Great Western Railway, on 30th July, 1920. It was a modest beginning—first a sale of fruit in an inn yard—but from the time of opening to the end of the year the turnover amounted to £11,308. Encouraged by the results of the effort land was acquired the following year, three large flight sheds were purchased from a disused aerodrome, and the turnover for the year ending 31st January, 1922, rose to £22,567. What the Grange Court Market must mean to the district is shown by the string of vehicles to be seen outside on any market day in the season bringing the fruit in, the big motor lorries from the mining centres in South Wales taking it away, and vehicles making frequent journeys with it to the station close at hand. There is no township or village even at Grange Court, but only a railway station and an inn, and the market is an excellent illustration of selling produce actually at the point of production.

The executive business of the Society is conducted by the Committee of Management, of which Mr. Bruce Swanwick has been Chairman since the commencement, and at Cheltenham and Grange Court there are Markets Committees to manage local affairs with representation on the Committee of Management. The latest venture was the opening in 1922 of a local market

at Berkeley, mostly for the sale of apples, and as yet this effort is in its infancy. There is no reason why it should not develop, however, because the far-famed Berkeley Vale is a land of orchards, and apples do well there.

Non-Returnable Packages.—Amongst the markets in the western counties those controlled by the Gloucestershire Society can claim to be the pioneers in the use of non-returnable packages for the conveyance of fruit from the market to its destination. In this part of the country the square wicker pot hamper, holding about 56 lb. of apples, 72 lb. of plums, or the same weight of pears, has been an institution ever since markets were established, and only those who control markets know what a responsibility these pots are, how great is the depreciation for losses and wear and tear, and the amount of capital that is required to maintain a supply. To buyers the paying of deposits and the returning of pots is a source of continual anxiety, while no railway company ever appears to have realised the fact that it is as important to convey empty pots back to a market as it is to get full receptacles to their destination. Further, it cannot be claimed that the pot hamper is a good package for fruit. It is too big for ripe plums and the rough ends of willow sticks are not good for either apples or pears.

The Gloucestershire Society therefore decided to go in for non-returnables, a small light receptacle for plums and choice apples and pears, and a bigger package to take the place of the pot hamper. It was a bold step, as the west-country grower is not quickly converted either to new ideas or to new packages, and some have been loath to part with the time-honoured pot. Buyers, on the other hand, have welcomed the idea, and they prefer as a rule to pay their share of the cost of the package and be relieved of further responsibility. In addition to this the Society has had to experiment, and the Committee do not claim now that they have got an ideal package. They have had to educate makers of non-returnable receptacles in the matter of turning out something that is light, cheap and durable, and the mistakes have been made that are inevitable in such circumstances. Nevertheless, the Society has reason to be encouraged by the results of the step it took, and just as the overseas grower has always sold his fruit in non-returnable packages, it looks as if home producers will also follow in line.

The Grower's Number Scheme.—Topping always has been and still is the bugbear in fruit and vegetable auction markets, and the result of it is that growers as a whole get a reputation

for unfair dealing, while buyers lose their confidence in the growers and in the market in which the produce is sold, and when their suspicions are aroused they bid less for the produce so as to protect themselves against it being topped. In short, topping is bad policy, apart from the dishonesty of it, because it must eventually tell against the grower, and in a market where it is prevalent the honest packer does not get credit for his honesty, nor the reward that honesty is supposed to bring.

The Gloucestershire Society has adopted a novel idea for dealing with the topping evil, winning the confidence of buyers and protecting the honest packer. It is called the Grower's Number Scheme and under it a grower can make application for a "Registered Grower's Number" accompanied by a declaration signed by the applicant that in the packing of all fruit, tomatoes, cucumbers, vegetables and cut flowers sent for sale under such number the bulk fairly corresponds with the top layer of each of the packages in the consignment. As far as possible a special part of the market is set aside for produce to be sold under "Registered Grower's Number," and an examining committee, consisting of two buyers and two growers with an independent chairman, is appointed in each market with power to examine any package and suspend any grower under a registered number who has failed to comply with the rules. There are various penalties and other conditions, but enough has been said to show that the Society is at least progressive in its aims. The number scheme has not been in operation long, but it can safely be said that it has great possibilities, and is a commendable attempt to do away with the grave reflection that is cast on home-grown produce.

Amongst its other activities the Society has periodical market shows at which prizes are given for packed fruit, and it is always open to receive suggestions from any of its members for improvements.

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EGG-LAYING TRIALS IN GLOUCESTERSHIRE.

H. S. WRIGHT,

Hon. Secretary, Gloucestershire Laying Test Society.

AMONGST the food producers of this country it is probably true that there are none at the present moment more scientific than poultry keepers, and it is largely the desire to obtain exact knowledge on the subject of egg production that has led to the establishment of laying tests in various counties. Gloucester-

shire is no exception to the rule, for in this county instruction in the scientific methods of poultry keeping has been given for years past under the auspices of the Agricultural Education Sub-Committee. In addition to this the stock of small poultry keepers has been improved considerably through the egg and chick distribution scheme of the Ministry of Agriculture. There was little trap-nesting done, however, before the appointment of the present instructor in poultry keeping, and few of the poultry keepers in the county had exact knowledge as to the laying capacity of individual members of their flocks.

Suggestions that Gloucestershire should have a laying test of its own took concrete form at a meeting called at the Shire Hall, Gloucester, in November, 1921, by the Agricultural Organiser. The meeting was representative of the poultry-keeping interests in the county, and not only was assent given to the proposal, but it was made possible by the financial support promised by those present.

From the day of the inaugural meeting, when the Gloucestershire Laying Test Society was formed, the movement has never looked back. It has the distinction of belonging to the poultry keepers who established it, but such an example of self help in a venture that was essentially educational could not fail to enlist the sympathy of the County Agricultural Education Sub-Committee, and this was shown in a practical manner after the test was started, by a grant towards establishment expenses. The credit, however, for forming the society and starting the test belongs to Gloucestershire poultry keepers, and the subscribers feel—quite rightly—that it is something which belongs to them; consequently they display a greater interest in it than they might have done if it had been established in any other way. The society considers itself fortunate in having Lord Bledisloe as its President and Mr. R. A. Johnson as Chairman of the Committee. Rules provide for a President, Patrons, Hon. Treasurer, Hon. Secretary and Members, with headquarters at the Shire Hall, Gloucester. The society has the assistance of the agricultural organiser, and of the county poultry-keeping instructor, who is responsible for the supervision of the test arrangements. The society is open to members only on the payment of a minimum subscription of one guinea, which is not repeated, and it is hoped that, if and when the society becomes self-supporting, these subscriptions, or part of them, will be repaid at the discretion of the committee, pro rata to the amount subscribed.

Following the formation of the committee and the framing of rules, the actual business of the test was taken in hand, and the offer of Messrs. A. M. & R. A. Johnson to place a portion of their farm at Chalford at the disposal of the society for holding the test was gladly accepted. Messrs. Johnson undertook the management, with the help of the poultry instructor. The test ground is in an exposed position on the Cotswold Hills, 600 ft. above sea level, so that the birds have none of the advantages that a situation more sheltered might afford.

The test, which in the first year was confined to Gloucestershire, is divided into two sections—(a) open to any poultry keepers, and (b) confined to owners of not more than 50 laying head—each section being sub-divided into heavy and light breeds respectively.

Each house is divided into two pens with a floor space of about 4 square feet per bird, fitted with three trap-nests and a grass run of 120 square yards, an average of 24 square yards per bird.

A ready response was made by poultry keepers in the county to the invitation of the Committee to enter their birds, and all the available pens were taken when the test commenced on 7th October, 1922. The birds were delivered to the ground one week before the commencement of the test, and each bird was examined by the poultry instructor before being passed as sound. After the week of so-called probation, Messrs. Johnson took over the birds, and the individual recording of the eggs commenced.

The test ground, overlooking the beautiful Stroud Valley, presents a picture that could hardly fail to appeal to any poultry enthusiast, as the 52 pens, obviously erected with a due regard to efficiency and economy, with the wired runs attached, give the whole a neat and business-like appearance.

The duties of feeding, re-setting the trap-nests and collecting the eggs take up the time of one man; the eggs are carried into the bungalow-office, where they are weighed separately and points are given to the competitor concerned according to their weight. The method of scoring is as follows:— The test of 48 weeks is divided into 3 periods, consisting of 12, 24 and 12 weeks respectively, as is shown in the following summary:—

	<i>First 12 weeks.</i>	<i>Next 24 weeks.</i>	<i>Last 12 weeks.</i>
1st grade eggs weigh	1 $\frac{1}{8}$ oz. or over.	2 oz. or over.	2 oz. or over.
Score ...	5	4	5
2nd grade eggs weigh	1 $\frac{1}{8}$ oz. but under 1 $\frac{1}{4}$ oz.	1 $\frac{3}{4}$ oz. but under 2 oz.	1 $\frac{3}{4}$ oz. but under 2 oz.
Score ...	4	3	3

Thus, during the first twelve weeks 5 points are given for each first-grade egg and 4 points for each second-grade egg. During the next 24 weeks, when eggs are plentiful, the standard of weight per egg to be reached is raised and only 4 points are given for a first-grade and 3 points for a second-grade egg.

Third-grade eggs are recorded, but no points awarded.

In the first year's test there were 52 pens, with 260 birds, divided into: Section A—Light Breed, 26 pens; Section A—Heavy Breed, 20 pens; and Section B—Light Breed, 6 pens. The mortality, in spite of the exposure and elevation of the ground, was less than 1 per cent., which reflects great credit on the general management of the test. The total number of eggs collected from the 260 birds competing was 50,978, giving the high average of 196 per bird. The leading pens of heavy and light breeds averaged 240.4 and 240.6 eggs per bird respectively, while the highest individual bird (White Wyandotte) laid 301 eggs during the 48 weeks. No doubt the fact of the test commencing early and the stock sent in by breeders being especially good, had a great effect in obtaining these results.

The first Annual General Meeting of the Society was held at the Shire Hall, Gloucester, on 8th December, when challenge cups and trophies given by various donors, and the Society's gold, silver and bronze medals, and certificates of merit were presented to the successful competitors by Lady Bledisloe.

There is also an open county section for ducks, and the first year saw an entry of 11 pens (4 birds in a pen), the recording of which commenced on 3rd November, 1922. In this section the leading pen averaged 175.5 eggs per duck for the 48 weeks. The ducks are housed separately and run in flock.

Prompt reports are issued to all the leading poultry and county papers and also to each competitor, and the closest co-operation exists between the society and the press.

The members of the society and the committee are to be congratulated on the results of the first year's work, and the test has done good in indicating the laying capacity of the birds of different breeds kept in the county. For the second year a single-bird test, open to the counties of Hereford, Somerset, Wilts and Worcester, as well as Gloucester, has been arranged, and 56 pens (pullets 44, and ducks 12) are now competing, as well as 52 pens containing 5 birds each. The county duck pens have been increased to 14.

APRIL ON THE FARM.

J. R. BOND, M.Sc.,

Agricultural Organiser for Derbyshire.

Weather Notes.—People usually associate the idea of April with showery weather, yet this month has normally the lowest rainfall of all the twelve in most parts of Britain. Generally it is a period in which the land dries considerably and in which showers assist rather than hinder the work of producing a tilth. Sometimes, however, a wet April followed by a dry warm May so disorganises the work on heavy land, which gets baked, as to prevent the sowing of fields intended for mangolds and swedes and thus increases the area of common turnips and bare fallow. The temperature of the air rises appreciably in April, and with the extended duration of daylight and bright sunshine, outdoor vegetation begins to come into active growth.

Soil Moisture.—Autumn- and winter-sown cereals, being well rooted and established before the return of drying weather, are usually well able to endure a dry growing season; indeed they yield best in warm dry seasons. Spring-sown cereals, however, grow short and yield light if the season has been dry and the moisture reserves in the soil have not been well husbanded. Of the "green" crops, potatoes, kohlrabi and sugar beet, all being deep rooted, can endure drought—provided that the soil is not poor and has been properly worked to the depth necessary for their full root development. Mangolds are intermediate in character, capable of moderate yields under dry conditions but producing the heaviest crops on land furnishing a liberal and regular supply of soil moisture. Swedes and turnips are very dependent on sufficient moisture.

In the case of corn crops, moisture may be conserved by maintaining a loose surface on the soil until the crop covers the ground. Considerable loss of moisture may occur if the soil is left too fine and firm on the surface after sowing; where practicable the harrow rather than the roller should be the last implement used on spring corn. Even after inter-seeding with grass and clover seeds, it is better to finish with the harrow rather than the roller.

In the spring preparation of clean land for roots, moisture is conserved by avoiding undue exposure of the undersoil to the air and sun, and by carrying out the necessary tillage operations in a manner likely to restrain the tendency of the soil to form hard clods. As soon as the land is dry enough for preliminary

surface tillage, it may be lightly harrowed to form a surface mulch, under which the soil will steadily come into condition for further working. In the subsequent operations, clod formation is avoided by not working too deeply at first but by attaining the requisite depth in successive stages. As a rule deep ploughing should be avoided at this time of the year. Where the eradication of weeds is of greater importance than the conservation of moisture for the green crop, the above methods may have to be departed from.

Mangold Sowing.—It is well known that mangolds yield best when an early plant has been secured; and it is recognised good practice in most districts to try to have the mangold land ready and drilled in April. The earliness of the plant, however, is not determined wholly by the time of sowing; mangold seeds do not begin to grow until the soil attains a mean temperature of about 48° F.; and it may be the end of April or the first week in May (depending on soil, situation, district and season) before the soil temperature attains this figure. The best “plant” is secured when the seed comes away soon after sowing; hence it is not uncommon experience for the crops drilled at the end of April to germinate better than the earlier sowings.

Mangold seeds also require shallow covering (about 1 in.) and a well-settled seed-bed. Where possible the ridges should be drawn out (preferably east-west) and left to settle and warm up a few weeks before drilling. Just before sowing the ridges should be chain-harrowed lengthwise to kill annual weeds, to crumble or remove clods and to freshen the soil for the reception of the seed; the ridges should not be made up again at this stage. Where it is necessary to drill on recently-formed ridges, and especially when the tilth is rather coarse, the ridge-roller should precede the drill; otherwise much of the seed may trickle down too deeply into the ridge and the top soil may be too loose and dry for regular germination.

It is advisable to sow plenty of seed, observation showing that the seedlings come up either thickly or hardly at all. The quantity of seed necessary varies from 8 to 12 lb. according to the closeness of the drill rows. In selecting varieties the results of local trials should be consulted. Some varieties yield very heavy crops, but the roots are of comparatively poor feeding and keeping quality.

“Seeds.”—A good clovery bed of seeds is a valuable asset. Clover hay has been found to give exceptionally good results as part of the ration of sheep or cattle fattening on turnips. Th-

comparatively high percentages of protein and calcium salts in clover hay also add to its value as winter fodder for young stock and dairy cows. The crop usually yields better than old meadow land, which is apt to cut light when the rainfall has been low in April and May. Moreover, a strong growth of red clover has a beneficial effect on the farm; not only does it add to the supply of nitrogen on the holding, but the abundant leaf and root residues of the crop enrich the soil in organic matter and the strong tap roots open passages down into the subsoil. Certain farmers occupying stiff coal-measures land in East Derbyshire a few years ago tried the omission of the "seeds" crop from one or two rotations, but found the land became almost unworkably wet in consequence.

There are certain drawbacks to the "seeds" crop; it dries the soil to a considerable depth, so that on non-retentive land and in dry localities wheat following this crop may come up weakly, unless the clover has been ploughed down early. The chief drawback, however, is that the red clover plant is liable to failure from so many different causes.

On a farm near Chesterfield the writer recently saw two beds of maiden seeds in adjoining fields; the soil (heavy loam on coal measures), previous crop (oats), seeds mixture, date of sowing and method of covering, were identical; yet one field had a complete failure of the clover, while the other bore a full and strong plant. The latter field had been limed in the autumn of 1921.

On a farm near Derby may be seen a field (keuper marl) in which one-half bears an excellent bed of clover, while from a line in the middle of the field southwards there is scarcely a clover plant (except on the headlands). The only difference in treatment had been the application of 3 tons of lime per acre to the northern portion six years ago. On part of the southern (failed) portion an experiment had been laid out with various kinds of clover—broad red, late-flowering red and alsike—but none of these plants had come well.

The above two cases illustrate the importance of lime to this crop. Lime is only one factor, but it is a potent one; and on fields where clover seeds are apt to "miss" in large patches, shortage of lime may be suspected, and the soil should be tested for "lime requirement."

On another farm in the Repton district last year, part of a field of oats in which "seeds" had been sown was top-dressed with nitrate of lime. When seen by the writer in November last, there was a full, good plant of red clover on the part where the

nitrate of lime had gone, but very little on the untreated part. This land is light hungry loam, deficient in both lime and organic matter.

A fourth case from last year's experience was that of a plant of clover that germinated immediately after sowing and then quickly disappeared. This field—coal measures clay—had been limed in 1921 and the cover crop was wheat, rather high at the time of sowing. Two causes seemed to account for the loss—insufficient covering of the seeds and the presence of large numbers of slugs.

The Aberystwyth experiments, which have been reported upon from time to time by Capt. Williams, appear to have gone far enough to justify the recommendation that grass and clover seeds should be well covered after sowing by seed or chain-harrowing (not by rolling), and the soil should be dry at the time of seeding. Drilling the seeds with the special clover-seed drill, or with an ordinary Suffolk drill minus the lever-weights, gives good results in south Derbyshire. The writer has also seen good takes of clover and grass seeds under spring-corn, where the small seeds had been mixed with the oats or barley and all drilled together. The germinating corn opens the way for the smaller plants, which would otherwise be unable to push through such a depth of soil.

Seeds Mixtures.—Ready mixed seeds may give results equal to those put together by the farmer himself. The advantage of sowing a mixture of known composition, however, lies in the guidance it affords for the making up of suitable and perhaps better combinations in the future. The following mixture is one adopted as a standard for one year's ley in the writer's trials:—

	lb. per acre.	
Perennial rye grass	6	} total 22 lb
Italian " "	6	
Cocksfoot	3	
Broad red clover (British)	3	
Single-cut cow grass (British)	3	
Alsike	1	
* * * * *		

MANURES FOR APRIL.

H. V. GARNER, B.A.,

Rothamsted Experimental Station.

Top-dressing Cereals.—At this time of the year farmers are deciding whether the wheat and oats have come through the winter with enough vigour to make a full crop, or whether a top dressing will be necessary to push on the plant. The

yellow starved appearance shown by cereals after a prolonged and wet winter is largely due to lack of available nitrogen, for the nitrates accumulated in autumn are to a large extent washed out of the upper layers of the soil by rain. Fortunately, this loss can be made good by the use of quick-acting nitrogenous fertilisers, and expenditure in this direction is usually well repaid by the increase in crop produced.

The forms in which spring top dressings are most often applied are as follows :—

(1) *Nitrate of Soda*.—Owing to its quick action this fertiliser should only be used as a top dressing. It is immediately available for the plant and is not retained by the soil, consequently it should be applied when fairly rapid growth is possible. Nitrate of soda has a special value for late top dressings; or in cases as of insect attacks, where an immediate response is desired.

(2) *Nitrate of Lime*.—This fertiliser is much the same as nitrate of soda in its effects on the crop. It finds useful application in certain cases where experience shows that nitrate of soda spoils the tilth of heavy land. It is sold in casks in granular form, and a good drying day should be chosen for its application, as under moist conditions nitrate of lime becomes sticky and difficult to handle.

(3) *Sulphate of Ammonia*.—This is the most concentrated and also the cheapest per unit of nitrogen of the common nitrogenous fertilisers. Since it is retained by the soil and has to undergo certain chemical changes before it is in a condition to feed the plant, this manure is somewhat less liable to loss in wet weather than the nitrates. Under the warm conditions of spring its conversion into nitrate is rapid, and the effect of a dressing of sulphate of ammonia can usually be seen in about a fortnight. This fertiliser gives its best results on soils which are supplied with lime. It has no ill effect on the texture of clays.

(4) *Soot*.—The main value of this popular dressing lies in the sulphate of ammonia it contains. The soot from dwelling houses is richer in nitrogen than soot from industrial sources, and an ordinary sample will contain about 4 per cent. of nitrogen. Twenty bushels of soot is approximately equivalent to 1 cwt. of sulphate of ammonia.

The quantity of top dressing to be used will largely depend on the farmer's judgment as to how much the crop can take without "going down." Recent experiments at Rothamsted indicate that, on land in only medium condition, the common

dressing of 1 cwt. per acre of sulphate of ammonia can usually be raised to 2 cwt. with satisfactory results, particularly in the case of a second straw crop. It is also indicated that if for some reason a top dressing has been delayed until late in the season, say till early in May, a fairly heavy dressing of up to 2 cwt. of sulphate of ammonia is proportionately more effective than a light dressing.

Manures for Potatoes.—The potato crop is dependent for its proper growth on a readily available and plentiful supply of plant food, and extensive trials have shown that a well-balanced mixture of artificials, in addition to a moderate dressing of dung, is more effective than a heavy dressing of dung used alone. This is well brought out by the average results of 353 experiments carried out on Irish farms over the seasons 1901 to 1911 :—

<i>Treatment per acre.</i>							<i>Potatoes per acre.</i>	
							<i>Tons.</i>	<i>Cwt.</i>
No Manure	...	...	...	...	...	...	4	0
15 tons dung	...	...	...	...	...	...	8	4
20 " "	...	...	...	...	...	...	9	2
15 " " + 1 cwt. sulphate of ammonia...	...	...	...	...	...	...	9	3
15 " " + 1 cwt. sulphate of ammonia + 4 cwt. superphosphate	...	...	...	...	...	...	9	19
15 tons dung + 1 cwt. sulphate of ammonia + 4 cwt. superphosphate + 1 cwt. muriate of potash	...	...	...	...	...	...	10	17

A second characteristic of the crop is its dependence on a supply of potash in the artificial mixture. The need for potash is greatest on light soils and in the absence of dung, but even on soils of a heavier nature and where dung is used, potash should still be included. The following results were obtained at Rothamsted in 1923, the figures being averages of triplicate plots :—

<i>Treatment.</i>					<i>Potatoes, Tons per acre.</i>	
					<i>With dung.</i>	<i>Without dung.</i>
No artificials	...	...	...	...	10.5	8.0
Artificials without potash	...	...	...	...	11.7	9.7
Artificials with sulphate of Potash	...	...	...	...	12.4	12.2

Note.—Artificials with 15 tons of dung were superphosphate 4 cwt.; sulphate of ammonia $1\frac{1}{2}$ cwt.; sulphate of potash $1\frac{1}{2}$ cwt. per acre. Without dung they were 6 cwt., 2 cwt. and 2 cwt. respectively.

Experiments are also in progress on the question of the nitrogen supply to potatoes, and although sulphate of ammonia is seldom given in larger quantities than 1 to $1\frac{1}{2}$ cwt. per acre where dung is used, there is reason to believe that the dressing could often be increased with advantage up to as much as 3 cwt.

per acre. Thus, in 1923, the yield of certain Rothamsted plots dressed with mixtures containing increasing quantities of sulphate of ammonia were:—

<i>Treatment per acre.</i>					<i>Potatoes. Tons per acre.</i>
Dung + artificials	without nitrogen	...	...	...	12.0
" + "	with 1½ cwt. sulphate of ammonia	...	...	...	13.7
" + "	with 3 cwt. sulphate of ammonia	...	...	...	15.1
" + "	with 4½ cwt. sulphate of ammonia	...	...	...	14.8

Note.—Dung 10 tons; superphosphate 4 cwt.; sulphate of potash 1½ cwt. per acre. The figures are means of duplicate plots.

For ordinary conditions the following dressings per acre may be used:—

<i>a.</i>	<i>b.</i>
15 tons dung.	No dung available.
4 cwt. superphosphate.	6 cwt. superphosphate.
1½ to 2 cwt. sulphate of ammonia.	2-3 cwt. sulphate of ammonia.
1 to 1½ cwt. sulphate of potash.	1½ to 2 cwt. sulphate of potash.

The artificials should be mixed and applied in the drills in spring. If desired 2 cwt. of superphosphate may be replaced in the mixture by 2 cwt. of steamed bone flour, which would cause the manures to work better in the distributor.

The Need of Lime.—The condition of clover leys in spring will often indicate that the farm is running short of lime, for none of the common crops are so sensitive to soil acidity. If clover looks poor and patchy and the field has been yielding badly in previous crops, it is worth while to have the soil tested for lime. If, as is likely, a marked deficiency is reported, chalking or liming is the only way to recover the productiveness of the land. The commonest substances used to supply the necessary lime are:—

(1) *Burnt Lime.*—This material is supplied in lumps, which have to be slaked to cause them to break down; or as ground lime, which is ready for sowing without further treatment. Two tons per acre is about the smallest dressing which can be uniformly spread by shovels from heaps in the field. Smaller dressings are better applied with a manure distributor.

(2) *Ground Limestone.*—This is finely powdered limestone rock and is applied in a similar manner to ground lime. In making a choice between ground lime and ground limestone it must be borne in mind that 1 ton of ground lime is as effective as about 35 cwt. of ground limestone. Hence, if the former can be obtained at 50s. per ton on the farm, the latter is worth about 29s. per ton on the farm.

(3) *Lump Chalk*.—Farmers in chalk districts can often obtain this material for little more than the cost of carriage. Dressings of 10 to 20 loads per acre may be applied. The chalk is gradually pulverised by the action of frost and cultivation, and the good effects of such a dressing will last for many years.

(4) *Waste Limes*.—These materials from paper mills, gas works, and other industries are often obtainable at what appears to be a very low price. It is advisable before buying to have an analysis made and then to compare the cost of the actual lime in these substances with that of ordinary burnt lime from some local source.

Usual dressings for sour soils are from one to two tons per acre of burnt or ground lime, or its equivalent of ground limestone. If more lime happens to be used than is required to sweeten the soil a reserve is built up which will postpone the necessity of further applications. To prevent the soil from again becoming sour, dressings of ground lime applied with a manure distributor at the rate of about 10 cwt. per acre every four or five years will usually suffice.

Poultry Manure.—The neglect which poultry manure often receives from farmers and small holders is all the more notable in view of the high value put by agriculturists upon organic manures as compared with artificial fertilisers. Only in those cases where the birds are kept more or less permanently on grass or arable land is the manurial value fairly completely realised. The loss occasioned by careless handling of the accumulated manure from roosts and coops is considerable, and may amount to about one-half of the original value.

The quantity of poultry manure made under different conditions has been ascertained,* the most complete figures relating to fowls. Calculated on the basis of 100 head some typical results are approximately as follows:—

100 Head.	Period.	<i>Fresh Manure produced.</i>
Breeding fowls	1 year.	80 cwt.
Chickens (hatching till 13 weeks)...	13 weeks.	9 cwt.
Fattening birds	3 weeks.	5 cwt.

A thousand fowls will produce about 1 cwt. of manure per day in the houses and a similar amount outside. The annual production for England and Wales is estimated to be at least one million tons.

* See this *Journal*, March, 1907.

The composition of poultry manure depends on the type of bird from which it comes, fattening fowls giving a richer dung than those which are laying. The fresh manure is a rich fertiliser compared with farmyard manure; while air-dried poultry manure, though poorer than good guano, has a similar composition to rape cake. The following are typical analyses (figures being percentages):—

	<i>Manure from birds at liberty.</i>		<i>Manure from fattening birds.</i>		<i>Good Farm-</i>	<i>Rape</i>
	<i>Fresh.</i>	<i>Air Dry.</i>	<i>Fresh.</i>	<i>Air Dry.</i>	<i>yard Manure.</i>	<i>Cake.</i>
Moisture ...	59.5	10.0	70.3	15.0	72.6	10.1
Dry Matter ...	40.5	90.0	29.7	85.0	27.4	89.9
Nitrogen ...	1.75	4.00	2.28	6.52	.77	5.3
Phosphoric acid	1.00	2.27	.97	2.77	.39	2.5
Potash ...	.54	1.22	.55	1.57	.60	1.5

Regarded as a fertiliser, fresh poultry manure is richer in nitrogen than it is in phosphates and potash. It contains about $2\frac{1}{2}$ times as much nitrogen and phosphate as an equal weight of farmyard manure, but only about the same amount of potash. The bulk of the nitrogen is present in an easily fermentable form. The manure is therefore quick-acting, and care must be taken in storage or much of the valuable ammonia will be lost. Assuming that only one-half of the total nitrogen has a value equal to that of sulphate of ammonia, and that the remaining half has one-third that value; and calculating phosphate and potash at current unit rates in superphosphate and potash salts, the poorest of the above fresh samples has a manurial value of 22s. per ton, while that of the richest dried sample is 76s. per ton.

Evidence as to the value of poultry manures is provided by some field experiments on grass land carried out in Cornwall over a six-year period. The comparison was between 4 cwt. of poultry manure and a series of nitrogenous manures each providing the same amount of nitrogen as in 1 cwt. of nitrate of soda.

<i>Treatment per acre.</i>						<i>Hay : Cwt. per acre.</i>
						<i>Average over six seasons.</i>
No manure ...	...	...	...	...	...	9
4 cwt. superphosphate	...	...	...	...	...	15½
"	"	+ 1 cwt. nitrate of soda	...	...	...	31
"	"	+ sulphate of ammonia	...	...	...	30
"	"	+ dried blood	...	...	...	30
"	"	+ fish meal	...	...	...	30
"	"	+ guano	...	...	...	31
"	"	+ 4 cwt. fowl manure	...	...	...	30

Under the above conditions poultry manure was about as effective as one-quarter of its weight of nitrate of soda (or its equivalent in nitrogen), and would therefore be worth about £3 per ton at present prices.

Eight to ten hundredweights per acre of poultry manure constitutes an ordinary dressing, and to apply this amount evenly a fairly good physical condition is necessary, the fresh manure being too sticky and the air-dry manure too lumpy to be easily handled at this rate. The point to aim at in the management of the manure is to dry and pulverise it with as little loss of nitrogen as possible. Peat moss, sawdust, wood ashes, and gypsum are sometimes used for this purpose, but soil is quite effective and has the advantage of being readily available. In dealing with the accumulations of manure in houses and coops a good practice is to make shallow layers of the manure and of dry earth alternately in the proportion of about two parts of manure to one of earth. The heap is kept under cover and turned occasionally till it becomes dry and friable. Another method which favours quicker drying is substantially the same except that each layer of manure covered by earth is kept on a separate tray, the trays being stored in tiers in a shed. The fertiliser balance of poultry manure may be improved by the addition of superphosphate or basic slag and of some source of potash such as wood ashes or kainit. For manure dried as described suitable additions would be:—

Superphosphate or basic slag at $\frac{1}{5}$ th of the weight of the soil-dried manure.
Kainit or wood ashes at $\frac{1}{10}$ th " " "

The compound thus obtained could be used at from 15 cwt. to 1 ton per acre as a general manure.

Owing to its rapid evolution of ammonia in the soil, fresh poultry manure may injure the roots of young plants. The remedy is to conserve and balance the nitrogen rather than to ferment it away by turning over the fresh manure with straw and leaves as is sometimes practised.

Unbalanced it is a forcing nitrogenous manure and suitable as a top dressing for green crops; it is also valuable for strawberries, fruit trees and tomatoes. For turnips, grass, and on heavy soils it should be enriched in phosphate; for potatoes, mangolds, and on light soils, addition of potash as well as phosphates is required.

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	Average Price per ton during week ending March 5th.					Cost per Unit at London
	Bristol	Hull	L'pool	L'ndn		
	£ s.	£ s.	£ s.	£ s.	s. d.	
Nitrate of Soda (N. 15½ per cent.) ...	14. 5	13.15	13.12	13.16	17.10	
„ „ Lime (N. 13 per cent.) ...	...	...	...	12.10	19. 3	
Sulphate of Ammonia, ordinary (A. 25¼ per cent.)	14. 2*	14. 2*	14. 2*	14. 2.*	(N)13. 7	
„ „ „ neutral (A. 25¾ per cent.)	15. 5*	15. 5*	15. 5*	15. 5*	(N)14. 5	
Kainit (Pot. 12½ per cent.) ...	...	...	...	2. 5	3. 7	
„ (Pot. 14 per cent.) ...	2.10	2. 6	2. 5	2.10	3. 7	
Sylvinit (Pot. 20 per cent.) ...	...	...	...	2.15	2. 9	
Potash Salts (Pot. 30 per cent.) ...	...	...	...	3.15	2. 6	
„ (Pot. 20 per cent.) ...	...	...	...	2.12	2. 7	
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7. 5	7.10	*7. 7	2.11	
Sulphate of Potash (Pot. 48 per cent.) ...	...	...	11.10	11.10	4. 9	
Basic Slag (T.P. 35 per cent.) ...	...	...	...	...	...
„ (T.P. 30 per cent.) ...	...	...	...	...	...
„ (T.P. 28 per cent.) ...	...	2. 4§	...	...	...
„ (T.P. 26 per cent.) ...	2.13§	2. 0§	...	...	...
„ (T.P. 24 per cent.) ...	2. 9§	1.16§	2. 0§	...	...
„ (T.P. 20 per cent.) ...	...	...	...	...	...
„ (T.P. 18 per cent.) ...	2. 3§	...	1.15§	...	...
Superphosphate (S.P. 35 per cent.) ...	4. 4	...	3.15§	3.15	2. 2	
„ (S.P. 30 per cent.) ...	3.16	3. 7	3. 3§	3. 7	2. 3	
Bone Meal (A. 4½. T.P. 45 per cent.) ...	9.10	8.15	8.17	8. 5	...	
Steamed Bone Flour (A. 1. T.P. 60 per cent.)	6.10	6.15†	6. 5	6.10†	...	
Fish Guano (A. 9-10, T.P. 16-20 per cent.)...	12.15	...	12.10	...	...
„ (A. 11. T.P. 10 per cent.) ..	...	...	...	13.10	...	

Abbreviations: N.=Nitrogen; A.=Ammonia; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire; London prices include delivery within a limited area. Cost to purchasers in other districts will be greater or less according to the distance of different purchasers from the works.

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MONTHLY NOTES ON FEEDING STUFFS.

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The Feeding Value of Spent Hops.—In a previous article in this *Journal** it was stated that “spent hops, apart from a possible medicinal value, are of no value to the stock feeder.” A correspondent has written inquiring for the basis of this statement, since spent hops form one of the many substances

* Jan., 1924, p. 960.

used as absorbent materials in molasses feeding stuffs. Spent hops have occasionally been used as a feeding stuff, generally in those countries where, in certain years, owing to bad hay harvests, difficulty is often experienced in obtaining sufficient forage to carry the stock through the year. Dried spent hops, according to Kellner, have the following analysis: Moisture 10.9, crude protein 15.3, ether extract (fat or oil) 6.8, nitrogen-free extract (carbohydrates) 39.6, woody fibre 21.0, ash 6.4. This material contains the following *digestible nutrients* in every 100 lb.: Crude protein 4.7 lb., carbohydrates 19.0 lb., woody fibre 3.6 lb. The starch equivalent per 100 lb. is 28.7. On the starch equivalent basis, every ton of dried spent hops is approximately equal to three-fifths of a ton of dried brewer's grains.

In *Scientific Feeding of Domestic Animals*, by Martin Klimmer (translated by Fischer), the following observations occur: "Spent hops are also occasionally used as a feeding stuff. When fresh they contain 25 per cent. of dry matter. Their digestibility, however, is low on account of the tannic acid that is present. Their nutritive value corresponds to that of grain straw." On the other hand, hops are said to be wholesome and to stimulate the digestive functions and the appetite.

In this country, spent hops are often used as an organic manure, and form the basis of at least one artificial manure. In view of the above evidence, it is reasonable to assume that as a feeding stuff, *per se*, spent hops are of little value to the stock feeder, and the writer would never personally use this material to replace concentrated feeding stuffs in a ration.

Economy in Feeding.—With the present prices of purchased feeding stuffs compared with the prices realised for the meat produced, many farmers are turning their attention to feeding their stock as far as possible on home-grown products, or on products that can be purchased more cheaply than they can be produced on the farm. It will be noted that fish meal is an expensive feeding stuff at present prices. Beans and peas are comparatively rich in protein, and many farmers are feeding these to their pigs in preference to buying the more expensive protein-rich feeding stuffs. A friend of the writer is at the present time keeping his pigs out at grass and feeding them on beans, crushed oats and mangolds. The brood sows receive a pint of beans thrown out on the grass, and roots are also thrown out in the afternoon. The young pigs are fed on bean meal and crushed oats, and are successfully finished off as London porkets on this diet.

DESCRIPTION.	Price per Qr.		Price per		Manurial Value per Ton.	Cost of Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv.	Price per lb. Starch Equiv.
			Cwt.	Ton.					
	s. d.	lbs.	s. d.	£ s.	£ s.	£ s.	£ s.	s.	d.
Wheat, British - -	—	—	11/3	11 5	0 16	10 9	71·6	2/11	1·56
Barley, British Feeding	—	—	11/—	11 0	0 12	10 8	71	2/11	1·56
" Canadian No. 4	37/3	400	10/5	10 8	0 12	9 16	71	2/9	1·47
Western	—	—	10/8	10 13	0 14	9 19	59·5	3/4	1·78
Oats, English, White -	—	—	9/8	9 13	0 14	8 19	59·5	3/—	1·61
" Black and Grey	—	—	11/4	11 7	0 14	10 13	59·5	3/7	1·92
" Scotch, White -	—	—	—	—	—	—	—	—	—
" Canadian No. 2	28/6	320	10/—	10 0	0 14	9 6	59·5	3/2	1·70
Western	27/9	—	9/9	9 15	0 14	9 1	59·5	3/1	1·65
" No. 3	25/6	—	8/11	8 18	0 14	8 4	59·5	2/9	1·47
" Canadian Feed -	23/0	—	8/1	8 2	0 14	7 8	59·5	2/6	1·34
" Argentine - -	45/6	480	10/7	10 12	0 13	9 19	81	2/5	1·29
Maize, Argentine - -	46/9	—	10/11	10 18†	0 13	10 5	81	2/6	1·34
" South African -	—	—	11/3	11 5†	1 13	9 12	67	2/10	1·52
Beans, Rangoon - -	—	—	23/6	23 10†	1 9	22 1	69	6/5	3·44
Peas, Japanese - -	—	—	—	—	—	—	—	—	—
Millers' Offals :—	—	—	—	—	—	—	—	—	—
Bran, British - -	—	—	—	8 0	1 7	6 13	45	2/11	1·56
" Broad - - -	—	—	—	8 15	1 7	7 8	45	3/3	1·74
Middlings Fine (Im-	—	—	—	10 2	1 3	8 19	72	2/6	1·34
ported)	—	—	—	8 17	1 3	7 14	64	2/5	1·29
" Coarse (British)	—	—	—	11 7	0 12	10 15	71	3/0	1·61
Meal, Barley - - -	—	—	—	12 0	0 13	11 7	81	2/10	1·52
" Maize - - -	—	—	—	10 0	0 19	9 1	85·3	2/1	1·12
" Germ - - -	—	—	—	9 10	1 8	8 2	75·6	2/2	1·16
" Gluten-feed - -	—	—	—	8 5	0 10	7 15	71·4	2/2	1·16
" Locust Bean - -	—	—	—	13 5	1 13	11 12	67	3/6	1·87
" Bean - - -	—	—	—	20 10	4 8	16 2	53	6/1	3·26
" Fish - - -	—	—	—	22 15	1 12	21 3	119	3/7	1·92
Linseed - - -	—	—	—	—	—	—	—	—	—
" Cake, English	—	—	—	13 2	1 19	11 3	74	3/—	1·61
9½% Oil	—	—	—	8 2	1 16	6 6	42	3/—	1·61
Cottonseed Cake, English	—	—	—	7 17	1 16	6 1	42	2/11	1·56
" 5½% Oil	—	—	—	—	—	—	—	—	—
" Egyptian	—	—	—	—	—	—	—	—	—
" 5½% Oil	—	—	—	—	—	—	—	—	—
Decorticated Cotton	—	—	—	13 7†	2 16	10 11	71	3/—	1·61
Seed Meal 7% Oil -	—	—	—	10 7	1 11	8 16	73	2/5	1·29
Coconut Cake 6½% Oil	—	—	—	8 0†	1 5	6 15	71·3	1/11	1·03
Palm Kernel Cake 6% Oil	—	—	—	7 0	0 8	6 12	51	2/7	1·38
Feeding Treacle - -	—	—	—	—	—	—	—	—	—
Brewers' Grains :—	—	—	—	—	—	—	—	—	—
Dried Ale - - -	—	—	—	8 7	1 5	7 2	49	2/11	1·56
" Porter - - -	—	—	—	7 17	1 5	6 12	49	2/8	1·43
Wet Ale - - -	—	—	—	1 15	0 9	1 6	15	1/9	0·94
" Porter - - -	—	—	—	1 10	0 9	1 1	15	1/5	0·76
Malt Culms - - -	—	—	—	8 0	1 15	6 5	43	2/11	1·56

† At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of February and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose coconut cake is offered locally at £10 per ton. Its manurial value is £1 11s. per ton. The food value per ton is therefore £8 9s. per ton. Dividing this figure by 73, the starch equivalent of coconut cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 2·24, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 13s. 6d.; P₂O₅, 4s. 1d.; K₂O, 2s. 6d.

FARM VALUES.

CROPS.	Market	Value	Starch	Food	Manurial	Value per
	Value per lb. S.E. d.	per unit S.E. s. d.	Equivalent per 100 lb.	Value per Ton. £ s.	Value per Ton. £ s.	Ton on Farm. £ s.
Wheat - - - - -	1.29	2 5	71.6	8 13	0 16	9 9
Oats - - - - -	1.29	2 5	59.5	7 4	0 14	7 18
Barley - - - - -	1.29	2 5	71.0	8 12	0 12	9 4
Potatoes - - - - -	1.29	2 5	18.0	2 3	0 4	2 7
Swedes - - - - -	1.29	2 5	7.0	0 17	0 2	0 19
Mangolds - - - - -	1.29	2 5	6.0	0 14	0 3	0 17
Good Meadow Hay - - -	1.56	2 11	31.0	4 10	0 14	5 1
Good Oat Straw - - -	1.56	2 11	17.0	2 10	0 7	2 17
Good Clover Hay - - -	1.56	2 11	32.0	4 13	1 1	5 14
Vetch and Oat Silage - -	1.43	2 8	14.0	1 17	0 7	2 4

* * * * *

NEW BUILDINGS FOR THE AGRICULTURAL COLLEGES AT LEEDS AND BANGOR.

THE growth of agricultural education in this country which was so seriously checked by the War has received fresh impetus during the past few years. There is a growing demand for further facilities in this direction, and it is worthy of note that two Universities both playing prominent parts in the agricultural life of the country are now engaged on building schemes which should greatly increase their usefulness in the sphere of agricultural education. The Institutions referred to are the University College of North Wales, Bangor, and the University of Leeds, both of which have recently undertaken the provision of new buildings for their agricultural departments.

University College of North Wales, Bangor.—The new buildings for the department of agriculture in the University College of North Wales, Bangor, form the central feature of the new science buildings designed as a part of the memorial to the officers and men of North Wales who fell in the War. The cost of these buildings is being met from the North Wales Heroes Memorial Fund, with a grant of £15,000 from the Development Fund towards the cost of the agricultural department.

At present the agricultural department is housed partly in rooms in the main college buildings, partly in a detached building formerly occupied by the education department, and partly in an army hut fitted up as a temporary laboratory for agricul-

tural chemistry. Apart from the extreme inconvenience of this arrangement, the accommodation is quite inadequate for the needs of a department which is extending rapidly, the number of students taking agricultural courses having considerably increased during the past few years. Amongst other recent developments of the department may be mentioned the appointment of a special advisory staff whose duty it is to devote themselves to the investigation of special local problems that affect agriculture, and to afford expert scientific advice free of charge to farmers in the College area.

The new agricultural building is designed in two blocks. The front block has two storeys and is set apart for administration, agricultural zoology and botany, and the investigation of animal diseases, while the rear block is allotted to agricultural chemistry. The roof of the front block is flat, and will accommodate green-houses and insect cages, space for which is also provided around the buildings. A central entrance gives access to the ground floor, which is occupied by the administrative offices, library, store rooms, a museum, preparation room and a large lecture room—37 ft. by 26 ft.—in addition to two rooms set apart for work in connection with animal diseases and rooms for the professors and lecturers. From this block two corridors lead to the agricultural chemistry building. This building contains a laboratory, a lecture room, and the necessary preparation and store rooms. The right wing is allocated to research and the left wing to forestry, which, however, is not strictly a part of the agricultural department.

On the first floor of the front block, accommodation is provided for zoology and botany, each subject having a large laboratory with a lecture room, preparation rooms and two research rooms. At the back are a range of rooms devoted to research and plant pathology and a lecturers' room. The veterinary department is also housed in this block.

The main building will be erected in rustic multi-coloured bricks with portland stone dressings in a simple renaissance style. The rear building will be finished externally in white cement and built internally in sand lime bricks unplastered. The foundation stone of the building, which was designed by Mr. Alan E. Munby, M.A., F.R.I.B.A., was laid by H.R.H. the Prince of Wales on 1st November, 1923.

University of Leeds.—The need for a self-contained department for the agricultural side of the University of Leeds has been apparent for many years, and, when the War broke out

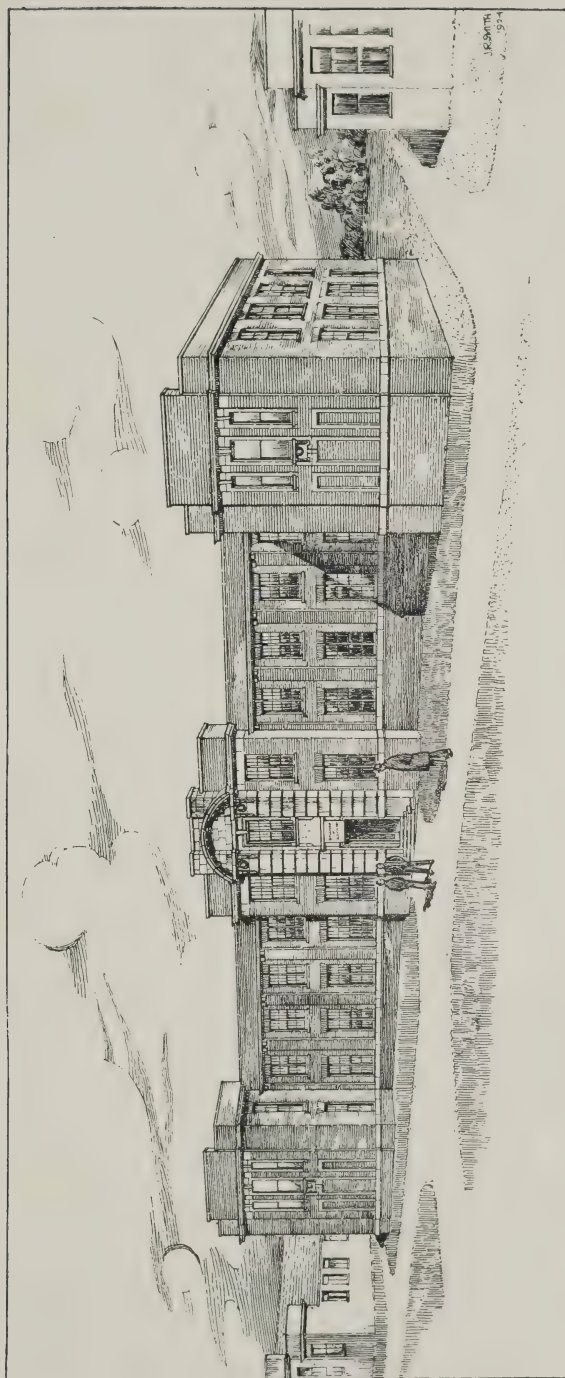


FIG. 1.—New Buildings for the Department of Agriculture, University College of North Wales, Bangor.

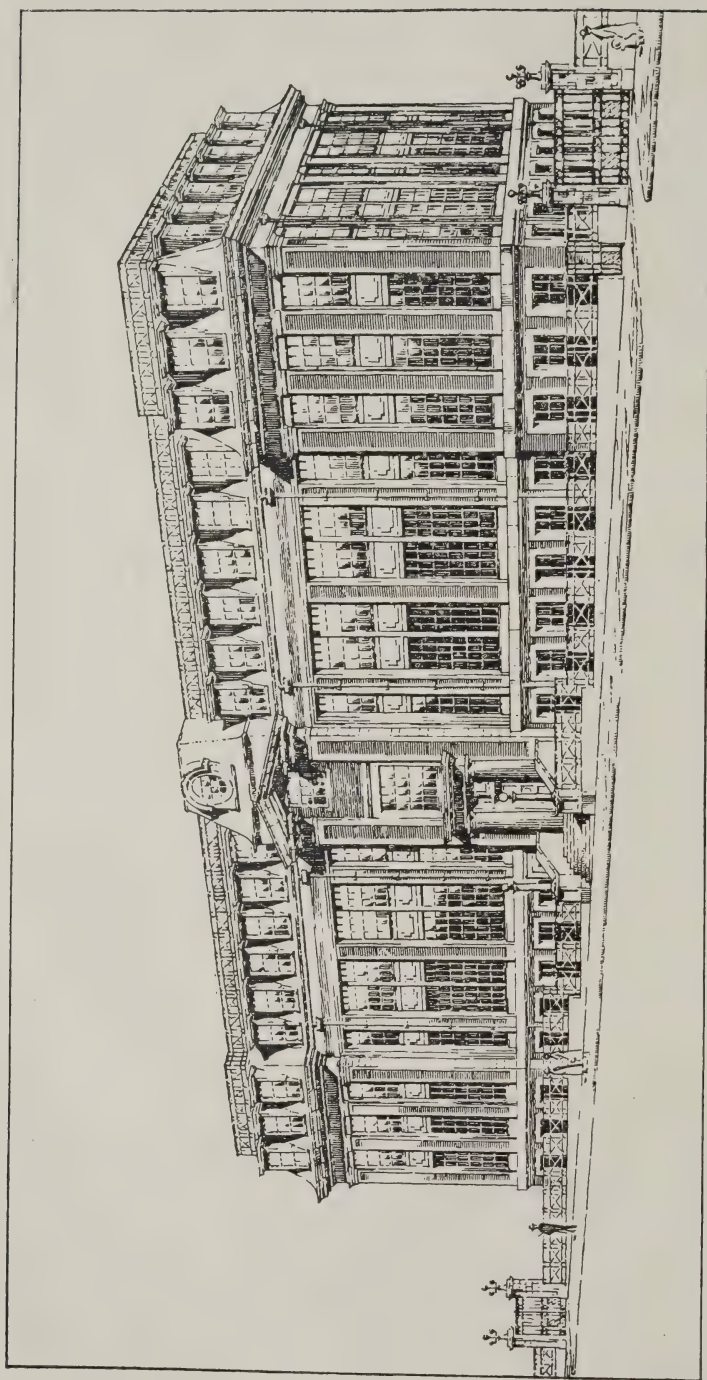


FIG. 2.—New Buildings for the Department of Agriculture, The University, Leeds.

tenders for a new building had actually been accepted. The scheme had then to be set aside, and the department has since had to make shift as best it could, in spite of ever-extending work. The administrative offices are in one building, while the teaching is done in three different sub-centres, agricultural chemistry alone occupying a part of the main building of the University which originally sufficed to house the whole agricultural department.

The extension is made possible by generous help received from various sources, now and in years past. Gifts were received from the late Mr. Walter Morrison, the late Mr. Henry Rutson, Major J. W. Dent, and Mr. Emmanuel. The Yorkshire Council of Agricultural Education has made a contribution of approximately £10,000, and £15,000 will be provided from the Development Fund. The University provides the site and the rest of the money required.

The agricultural department is administered by the Yorkshire Council for Agricultural Education which consists of representatives of the County Councils of the three Ridings, Leeds University, and the Ministry of Agriculture and Fisheries.

The department has extended the scope of its work considerably in recent years, particularly in an advisory capacity, and farmers are taking advantage in increasing numbers of the expert advice afforded them in their every-day problems of the soil and methods of cultivation. Farm cost accounting has also become a notable feature of the department's work, giving the farmer a new insight into the business management of his farm and helping him to re-adjust his methods of farming where they have proved uneconomic.

The new building has been allocated to a position on University Road west of the buildings of the textile (cloth-workers) group. A good street alignment is here available, and the building will occupy a plot 190 ft. long by 125 ft. deep. On the ground floor the largest rooms are a lecture room, measuring 50 ft. by 24 ft., a smaller room measuring 35 ft. by 19 ft. (both of these having the auditorium raised in stages), a museum 50 ft. by 27 ft., a library, secretarial offices and various small professorial or classrooms. The biological department begins on the first floor, where there are a general laboratory and research laboratory, a staged lecture room, research rooms of moderate sizes, a laboratory for advanced work, one or two private rooms and the necessary preparation, sterilising, store and other rooms. On the second floor are a large students'

laboratory, laboratories for chemical nutrition research, balance rooms (for staff and students), large and small lecture rooms and rooms for microscopy and other special purposes. The roof surface is also naturally adapted for outdoor and greenhouse work. The basement, which forms an important part of the accommodation, contains a students' common room, locker room, large machinery room, workshop and store rooms.

The external materials of the building will be stone and brick, but owing to the large window areas these are sparingly used and the structural strength will depend on a framework of steel. Mr. Paul Waterhouse, of London, is the architect, and the foundation stone will be laid on 14th April by Mr. Noel Buxton, Minister of Agriculture and Fisheries.

* * * * *

THE Ministry announces that under the scheme for awarding scholarships and maintenance grants for the sons and daughters of agricultural workmen and others, a number of scholarships at Universities, Agricultural Colleges and Farm Institutes, are offered for award this year. The scholarships are provided out of the special fund for agricultural development voted by Parliament under Section 3 of the Corn Production Acts (Repeal) Act, 1921, and are confined to (a) sons and daughters of agricultural workmen, (b) sons and daughters of other rural workers, including bailiffs and small holders, whose financial circumstances are comparable with those of agricultural workmen, and (c) *bonâ-fide* workers in agriculture, the financial circumstances of whose parents are comparable with those of agricultural workmen.

The scholarships are of three kinds: Class I, for three or four years, tenable at Oxford, Cambridge, or other Universities which have Departments of Agriculture, enabling the holders to attend degree courses in agriculture or horticulture; Class II, for two years, tenable at University Departments of Agriculture or Agricultural Colleges, for one or other of the diplomas in agriculture, horticulture, dairying or poultry-keeping; and Class III, for short courses (not exceeding one year's duration) in the same subjects, at County Farm Institutes. Provided a sufficient number of suitable applicants is forthcoming, ten scholarships in Class I, ten in Class II, and about one hundred and fifty in Class III will be awarded for courses commencing in the Session starting at Michaelmas next. In each class the

value of the scholarship is such as will enable students to attend the courses in question without any financial outlay on the part of their parents.

Candidates for Class I and Class II scholarships must be at least 17 years of age, and must satisfy the Selection Committee that they have reached a sufficiently high standard of general education to derive full benefit from the course of instruction. In the case of Class I, preference will be given to candidates who have passed an examination which entitles them to enter a University. Candidates for Class III scholarships must be at least 16 years of age, and should possess a useful knowledge of ordinary school subjects. They will be required to produce evidence of their acquaintance with the practical operations of farming (or horticulture, dairying, or poultry-keeping, as the case may be), and, normally, they should have spent at least a year in such practical work.

Forms of application and all other information regarding the Scholarship Scheme may be obtained from the Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1, or from the County Authorities for Agricultural Education at the offices of County Councils. Applications should be forwarded to the County Authority for Agricultural Education not later than 30th April, 1924.

* * * * *

THE following note has been contributed by Dr. J. A. Hanley, of Leeds University Department of Agriculture:—

The Use of Precipitated Carbonate of Lime. Precipitated carbonate of lime is now being advertised by certain firms in the north of England at a price which allows of its delivery in bulk at some stations at a total cost low enough to compete with quick-lime. The material itself is quite suitable for use on the land provided that it arrives in a condition which will allow of satisfactory distribution. The question whether a farmer can use this material instead of ground quick-lime has been asked many times recently. This depends on (1) the relative prices of the two materials; (2) the amount of lime or carbonate of lime to be applied per acre. The precipitated carbonate of lime passes too slowly through the usual mechanical distributor; it is best carted straight on to the field and spread direct from the carts with shovels. Satisfactory distribution can, therefore, only be obtained if the material is used at the rate of at least 2 tons per acre. A dressing at this rate is equivalent to 1 ton of

quick-lime per acre, and if, therefore, a farmer intends to lime land at the rate of 1 ton of quick-lime per acre, he can, where transport does not make too serious an addition to the cost, do it more cheaply by using 2 tons of precipitated carbonate of lime per acre. Where the farmer intends to use lighter dressings of lime, such as the more usual 10 cwt. of quick-lime per acre, it is necessary to distribute the material mechanically, and he is in that case advised to use ground quick-lime.

The farmer should do his best to ensure that the precipitated carbonate of lime is loaded in a condition dry enough to make it spread easily, and he should always have the trucks sheeted. If the weather is wet during transport the material, if not sheeted, may arrive at the farmer's station in the condition of a sludge totally unfit to use until it has been allowed to dry again. One of the great advantages of carbonate of lime is that it can be stored at the farm (preferably under cover) indefinitely without deterioration and used at any time when it is convenient. It can be applied directly to growing crops without fear of injuring them. It does not "set" when wet, but falls again to a fine powder on drying. Like other materials used to supply lime to land, precipitated carbonate of lime should be applied *after* the land has been ploughed, and at a time when it can be thoroughly harrowed in.

The fact that carbonate of lime does not "set" if exposed to wet conditions, whilst still on the surface of the land, makes it preferable to quick-lime for application to permanent or temporary grassland, or in other cases where immediate cultivation is not possible. When comparing prices it should always be remembered that 1 ton of quick-lime is equivalent to about 2 tons of carbonate of lime.

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THE growing demand from commercial horticulturists for practical assistance and advice during the post-war years has resulted in the appointment of Horticultural Instructors by the Agricultural Education Authorities of nearly all the counties in which horticulture is practised on a commercial sale.

A rather striking instance of the useful work carried out by these committees is afforded by the demonstrations of spraying machines which were arranged recently by the Agricultural Education Sub-Committee of the Cambridgeshire Education Committee through its Horticultural Instructor.

**Spraying
Machine
Demonstration.**

Fruit crops in Cambridgeshire suffered very severely last season from the effects of insect and fungus pests. Plums and apples were especially severely attacked, and the crops were reduced almost to vanishing point. Plum trees were attacked by the two common species of aphid and by brown rot in its various forms. Many branches were killed and the dead wood showed innumerable pustules of the brown rot fungus. Apple trees were badly attacked by insects, chiefly the purple aphid. The result of this damage was that the attention of fruit growers was concentrated on the question of spraying their trees, and considerable discussion arose as to the merits and demerits of the various spraying materials and the best methods of their application.

The Committee, through its Horticultural Instructor, took advantage of these discussions and arranged for lectures on the various points and, at the appropriate season, for practical demonstrations in spraying. Mr. Paskett, the Horticultural Instructor, found that many growers particularly wanted advice as to the best machine to purchase, and he accordingly made arrangements with some of the principal firms of manufacturers to carry out demonstrations of their apparatus in the districts of Willingham, Cottenham, and Histon. The members of the West Cambs. Fruit Growers' Association co-operated by lending their fruit plantations, and by providing men and horses for moving the machinery and maintaining an adequate supply of water. Demonstrations were given from 11 a.m. to 3 p.m. on 15th, 16th, and 17th January. Various makes of dry sprayers were demonstrated, in addition to hand wet sprayers and large and small power sprayers. The weather was exceptionally fine for the first two days, and in spite of falling snow on the third day, the total attendance of fruit growers amounted to about 500. In addition parties of boys and girls from village schools attended the demonstrations.

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FOLLOWING on the last Martinmas Hiring Fairs the Board of Agriculture for Scotland issued a tabular statement of the rates

**Farm Wages
in Scotland.**

of wages prevailing throughout the country at that time. Particulars of the approximate cash wage and total weekly remuneration of each class of agricultural labour accordingly form a supplement to the Board's Monthly Agricultural Report for the 1st January. The Martinmas Fairs are second in importance only to those

held at Whitsuntide, for whilst many of the married men are engaged at Whitsunday on yearly contracts, the single men more frequently make six-monthly contracts at Whitsuntide and Martinmas.

Married ploughmen form one of the most important classes of Scottish farm workers and, like the single ploughmen and cattlemen, are divided into three grades according to experience and ability, the third grade comprising many youths. In the lower Clyde valley the total weekly remuneration of the first grade ranges from 41s. 6d. to 48s., of which 4s. 6d. to 9s. may be taken as the value of allowances in kind. First grade single ploughmen, on the other hand, range from under 40s. to 48s.; in the case of these workers the entire wage may be paid in cash or, if board and lodging is provided, as much as 25s. may be deducted for allowances. First grade cattlemen receive from 42s. to 52s. and shepherds from 36s. to 42s. per week.

In the eastern industrial area agricultural workers usually receive from 36s. to 49s., of which 11s. to 17s. is paid in the form of allowances in the case of married ploughmen and 12s. 6d. to 18s. in that of single men.

In the south-eastern part of the country married ploughmen receive from 36s. 6d. to 45s. per week, allowances varying in value from 2s. 6d. to 6s. On the other hand, most of the single ploughmen are paid entirely in cash, their wages ranging from 31s. 6d. to 43s. 6d. Cattlemen and shepherds earn from 36s. 6d. to 44s. and from 31s. 6d. to 49s. respectively.

In the north-eastern counties married ploughmen may obtain from 35s. to 40s. per week, of which amounts 11s. may be taken generally as the value of allowances. Single men may get up to the equivalent of 16s. in allowances, their total remuneration averaging from 32s. 6d. to 39s. per week. Cattlemen's wages range from 35s. to 42s. and shepherds 33s. to 48s. 6d.

The Western Highlands include the lowest paid area on the mainland of Scotland—Caithness—where ploughmen get only 28s. 3d. per week. Nearly 13s. of this amount is accounted for by allowances in the case of married men. Cattlemen get little more than ploughmen, but shepherds receive as much as 39s.

Women workers are generally receiving 3s. to 3s. 6d. per day, but in Ross and south-west Perth daily wages range as high as 4s. or 5s.

In view of the importance from the national standpoint of destroying rats and the increasing interest shown throughout the country in the subject, the Ministry, in accordance with the practice of past years, organised a special campaign of destruction for one week, the week selected being from 5th to 12th November, 1923.

The number of Local Authorities empowered to execute and enforce the Rats and Mice (Destruction) Act, 1919, had increased from 508 in 1922 to 577 in 1923, owing to the delegation by certain County Councils of their powers and duties under the Act, to minor Local Authorities. All these Authorities were informed by Circular on 12th September, 1923, of the Ministry's scheme, and the Circular embodied suggestions as to suitable lines of action to meet the particular circumstances of each locality. Instructions for making cheap and effective raticides were also sent.

Occupiers of lands and premises infested with rats are not always alive to the responsibility which rests upon them, under the above-mentioned Act, of keeping their lands and premises clear of the pests, and one object of the campaign was to enlighten the public on this point.

As an additional means of arresting public attention, the services of the British Broadcasting Company were enlisted, and a short talk on the general subject of damage done by rats and the need for rat destruction was broadcast by wireless on the evening before the "rat week" commenced, from all the stations of the Company.

The following statement shows the number of Local Authorities to whom the Circular Letter was sent, the number who have replied thereto, and the number who reported that special action had been taken:—

<i>Local Authorities.</i>	<i>Number.</i>	<i>Total replies.</i>	<i>Special action indicated.</i>
County Councils	63	42	28
County Boroughs	82	53	32
Metropolitan Boroughs	28	14	11
Town and Urban District Councils	309	119	72
Rural District Councils	95	38	23
TOTAL	577	266	166

In cases where there was no special action, the reasons given were, as a rule, either that the work of rat repression continued throughout the year, or that the district was comparatively free from rats.

The publicity methods generally adopted were :—

- (1) Circularisation of occupiers of premises, particularly those liable to infestation owing to the nature of the business carried on ;
- (2) Public lectures and publication of articles and notices in the local press ; and
- (3) Exhibition of placards and posters. At 15 places films and slides, dealing with the subject were exhibited during the week in the local Cinemas.

The following are some of the practical steps reported in connection with the campaign :—

- (a) Poison was obtained and distributed by 21 Local Authorities, 10 of which made no charge, while the other 11 sold it at cost price. One Local Authority who purchased last year a quantity of steel traps and loaned them as required, purchased a further supply this year, owing to the great demand.
- (b) Chemists and hardware dealers co-operated with the Local Authorities in 20 places and made a special display of raticides and traps in their shop windows during the week.
- (c) 63 Local Authorities set a good example by devoting special attention to the rubbish tips, sewage farms, refuse dumps, etc., under their charge.
- (d) House to house visits were made by Sanitary Inspectors in 20 districts and advice given on the spot.
- (e) Gassing methods were used in 8 places with the result that large numbers of rats were killed.

It is obviously impossible to estimate the number of rats killed during the week, but it is certain that it amounted to many hundreds of thousands. The “ rat week ” has undoubtedly been a success also from the point of view of enlightening the public and stimulating their interest in the matter.

A fact of special significance is that so many reports indicate a diminution in the number of rats now seen as compared with a few years ago. This shows that where continuous efforts are made by public bodies and private individuals to overcome the rat problem they meet with considerable success. The want of activity in some parts of the country in administering the Act is to be regretted because it must nullify to some extent the action of those authorities who are alive to the benefits of continuous repression of rats.

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Foot-and-Mouth Disease.—During the five weeks ended 23rd February, 1st, 8th, 15th, and 22nd March the number of outbreaks of foot-and-mouth disease were respectively 79, 100, 62, 60, and 38, the first two weeks representing a temporary, but marked, set-back in the progress recorded in the March issue of the *Journal*.

During the five weeks in question new centres of disease occurred at Keyston (Hunts), Sheffield (Yorks, W.R.), Stopsley (Beds), Benenden (Kent), Doncaster (Yorks, W.R.) (premises previously infected, but freed from restrictions), Burnham (Norfolk), Owston Ferry (Lincs), Quernmoor (Lancs), New Kilpatrick (Dumbarton) (also a recurrence of disease after restocking), Fulbourn (Cambs), Chatham (Kent), Witney (Oxford), Burnley (Lancs), Dereham (Norfolk), Kirkby Malzeard (Yorks, W.R.), Cheriton (Kent), and Winchcombe (Glos) (also a recurrence), and Warmley (near Bristol) Glos.

Several of the new centres mentioned were attributable to the introduction of infection into Northampton, Lancaster, and Banbury markets; the distribution from which was also responsible for numerous other outbreaks.

These incidents necessitated the imposition of restrictions in respect of areas usually of 15 miles radius from the outbreaks, although in some cases this radius had to be exceeded in view of the possibilities arising from market infection. The infected areas in Aberdeenshire, Forfarshire, Perthshire, Fifeshire, Cumberland, and Westmorland have now been released from restrictions, and small rectifications of boundaries have been made in other counties, but although extensive modifications of areas have been contemplated, the reappearance of disease before such Orders could become operative has necessitated the reimposition of restrictions, so that during the period under review no really effective reduction of the extent of areas has been possible. The outbreak near Bristol necessitated the closing of the Bristol Landing Place for Canadian and Irish animals.

The following table shows the details in respect of the period 27th August, 1923—23rd March, 1924 :—

Outbreaks	...	...	...	...	...	2,951
Counties affected :	England	...	...	...	...	39
	Wales	...	...	...	...	2
	Scotland	...	...	...	...	11
Animals slaughtered or authorised to be slaughtered :						
Cattle, 99,361.			Pigs, 45,646.			
Sheep, 38,717.			Goats, 121.			
Estimated gross compensation			...	...	£3,177,000	
Estimated receipts for salvage			...	...	£451,800	

* * * * *

Milk Advisory Committee.—The Minister of Health and the Minister of Agriculture and Fisheries have appointed a Joint Committee to advise their Departments on matters concerning the production, handling and distribution of milk and dairy produce, including questions relating to education and research, and any legislation, orders and regulations which may be under consideration. The Committee consists of the Lord Kenyon, K.C.V.O. (Chairman), Mr. T. Baxter, Mr. W. Buckley, Mr. T. J. Goodchild, Mr. J. J. Kearns, Mr. E. W. Langford, Mr. J. H. Maggs, Mr. A. Park, Mr. T. J. Roper and Mr. J. L. Shirley.

Mr. V. E. Wilkins, of the Ministry of Agriculture and Fisheries, 10, Whitehall Place, S.W., will act as Secretary to the Committee, and all communications relating thereto should be addressed to him.

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REPLIES TO CORRESPONDENTS.

Value of Gypsum.—D. F. asks whether calcium sulphate is of any manurial value and whether it makes heavy land work better.

Reply: Sulphate of lime (gypsum), in common with other forms of lime, would better be described as a soil improver than as a manure. It is not used so much now as formerly for application to the land, owing to the increasing use of superphosphate, which contains a considerable amount of this material.

The Ministry's Leaflet No. 170 refers on page 2 to the efficacy of lime generally in improving the mechanical condition of the soil; and some interesting observations on the effect of gypsum, chiefly on heavy soils, will be found on page 586 of the Victorian (Australia) Journal of Agriculture for October, 1923.

Spartina Grass.—C.E. asks for information about *Spartina Townsendii* or Townsend Cord Grass.

Reply: *Spartina Townsendii* is dealt with in the following papers:—(1) Kew Bulletin, 1918, p. 26: "*Spartina* and Coast Erosion"; (2) and (3) Kew Bulletin, 1919, p. 391, and 1922, p. 351; (4) Annals of Applied Biology, vol. VII (1920-21), p. 25: "*Spartina* Problems," by Professor F. W. Oliver, F.R.S.; (5) and (6) Journal of Ecology, vol. X, p. 22 (1922), and vol. XV, p. 102 (1923); (7) "*Tidal Lands*," by Carey and Oliver (London, Blackie & Son), 1918, 12s. 6d. (pages 176-184). To these may be added Kew Bulletin, 1907, p. 190; Stapf in Gard. Chron., Ser. 3, xliii (1908), p. 33, and in Proceed. Bournemouth Nat. Sc. Soc., V (1914), p. 76; Sherring in Proceed. Bournemouth Nat. Sc. Soc., IV (1913), p. 49; Prof. F. W. Oliver at the British Association, 1919; and Comptes Rendus de l'Acad. des Sciences, Tome 174, No. 16 (April, 1922), p. 1,084. Of the above Nos. (1), (2) and (3) have reference to an attempt, unfortunately not very successful, to colonise *Spartina* on the coast at Clevedon in Somerset. Here the tide proved eventually too strong. Nos. (5) and (6) are short notes referring to its appearance, believed to be spontaneous, but subsequently ascertained to be artificial, in the Dovey Marshes in the middle of Cardigan Bay. No. (6) is interesting as testifying to the comparatively high powers of resistance of the plant to grazing both by cattle and sheep. The most important paper is that by Professor Oliver (No. 4). This describes the original appearance of the species in 1870 in Southampton Water, and its gradual distribution as far as Pagham to the east and Poole to the west. The question whether it is a hybrid or a distinct species is left open. Its habit and behaviour in Christchurch and Pagham harbours are described. It is noted that it has been planted in the Firth of Forth, Wells (Norfolk) and the Harwich Estuary. At Clevedon and Sheerness it has been planted with the definite object of protecting the coast line from erosion. Its use as a food for stock is referred to and the question of its suitability for paper making is discussed. Artificial propagation is effected by planting roots and not by seed.

Soot.—F. I. writes as follows:—"Recently my house chimneys were swept by a chimney sweep who is an enthusiastic allotment gardener, so I asked his views on the matter. His answers were definite and interesting. Soot from a private house, he said, could be used at once (*a*) as a surface dressing to soil, or (*b*) to dig into the ground; but that about a month should

be allowed to elapse before it could safely be used to sprinkle over young foliage (as a slug deterrent) without scorching. Soot from a factory, he said, was, as a fertiliser, of no value whatever, because the heat in factory chimneys was so great that soot, as it formed, was again re-burned, and that factory chimneys were, so to speak, in a state of being constantly on fire. Consequently soot from factories was not black, but a reddish colour, and without any fertilising property."

Reply: The statement as to the superiority of household soot over industrial is borne out by a note on page 398 of Vol. III. of the Journal of Agricultural Science. This gives the analysis of nine samples, that from a kitchen chimney giving as much as 11 per cent. of nitrogen, that from a tall boiler chimney as low as 0.5 per cent. The other seven samples (household soot) averaged approximately 4 per cent. Flue dust from the Cambridge Rubbish Destructor, it is noted, contained no nitrogen. The reason why household soot is superior to industrial soot is partly explained by your sweep, and the enclosed extract from Sir Daniel Hall's "Fertilisers and Manures," p. 68, should serve to complete the explanation. The advice that soot should, if possible, be stored for some time before use is due to the fact that it may possibly contain ingredients injurious to plant life. As a matter of fact, when used as a soil fertiliser, it does need to have been previously stored; as a top dressing for growing crops it is wiser not to apply it until it has been kept for about a month."

The following was the extract enclosed:—

"Of these waste materials the most generally used is soot; its value, which is due as much to its physical effects upon the soil as to its fertilising constituents, has been known for the last three centuries at least. It has already been pointed out that coal contains one per cent. or more of nitrogen; in a fire some of this is evolved as ammonia when the coal is heated, and if it escapes combustion in the higher levels of the fire it is afterwards partially arrested by the particles of carbon constituting soot, which possess an exceptional power of condensing gases upon their surface. In the main soot is only an impure form of carbon; its fertilising value is due to the small and variable proportion of ammonia it has thus absorbed from the gases in the chimney. The percentage of nitrogen present may be as low as 0.5; in exceptional cases it may rise to 6.32 being the mean of a large number of analyses."

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NOTICES OF BOOKS.

The Poultry-Keepers' Text Book.—(E. T. Brown. London: Ward, Lock & Co., pp. 320, price 6s. net.) Contains in moderately condensed form much desirable information both for students of poultry-keeping and for practical breeders. Poultry-keeping nowadays embraces so many branches of both science and practice that it has become increasingly difficult to deal adequately in a single book with all aspects of the subject. Genetics, biology, chemistry and veterinary science all have a direct bearing upon poultry-keeping, while on the more practical side many poultry-keepers are brought sooner or later into contact with various problems of an agricultural or horticultural nature, in addition to the many questions of poultry-keeping practice and business.

The chapters dealing with breeding are carefully compiled and are written in clear, simple and concise phraseology, which should prove attractive to those poultry-keepers who, whilst possessing no special knowledge of the technicalities of genetics, are yet anxious to understand what light Mendelism and other experimental work in genetics can throw upon practical problems.

On the more practical side, much useful information is given regarding methods of more or less established practice, and it is pleasing to find that the author realises the necessity for dealing, even briefly, with agricultural and horticultural matters of general importance to poultry-keepers. The chapter on weights and measures, and the comprehensive glossary will save much time for students, whilst the reproduction of the poultry-house plans of the Ministry of Agriculture will, no doubt, be appreciated by those about to erect poultry-houses.

The book is well illustrated and is very readable. Though it cannot claim to be a comprehensive and detailed treatise on the poultry-keeping industry as a whole it should prove a very useful addition to the library of the student in poultry-keeping and of the practical worker.

Die Düngerlehre.—(N. Prianishnikow. Berlin: Paul Parey, 1923, pp. VIII, 450, fig. 84. Edited from the 5th Russian edition by M. von Wrangell.) A reviewer in the *Wiener Landwirtschaftliche Zeitung* makes the appearance of this book a text on which to hang a sermon on the need, agriculturally, for the gift of tongues. The agricultural theory and practice of various countries, is, he complains, too much confined in water-tight compartments. This is perhaps quite true as regards Russia, of whose agricultural science both the Germans and ourselves can do little more than glean rather scant excerpts and abstracts. Both the Vienna reviewer and the German editor—herself not unknown as an authority on soil questions—refer to the somewhat un-German style in which this translation is couched. For the foreign—the un-German—reader this is an unmitigated advantage. This book, happily, still preserves sufficient texture of the rock from whence it was hewn to be easily intelligible west of the Rhine. And what is more it is a most interesting work. It is always good, as the Vienna reviewer suggests, to view scientific problems from the angle of another nation's experiences. The agricultural problems and experiences of Russia naturally differ in detail from those of the rest of the world. Russia is a vast country, lacking the link of communications, and possessing practically unlimited supplies of raw phosphates. Hence the nitrogen question must be solved to a large extent by green manuring, and the native phosphate supply exploited to its fullest capacity. On both these, as on other questions, this book, designed originally by the author as a handbook for his students, contains much of absorbing interest. At the same time it is by no means professorial—it bears the stamp of the student not of the dogmatist, and gives the *cons* as well as the *pros*. It is well provided with illustrations, which make a ready and convincing appeal to the eye. In addition there are interesting chapters on the history of manuring and on the organisation of fertilising experiments. There is a short but useful section on the disposal of city refuse. We, at least those of us who cannot read Russian, are under a debt of gratitude to the German translator and editor for putting us in touch with what is at any rate a fresh exposition of an eternal problem.

Year Book and Annual Report of the Essex County Farmers' Union.—(Chelmsford. Issued by The Society. Price 2s. 6d.) A high standard is set by the Secretary of the Essex Farmers' Union, and the consequence is that this Year Book contains an attractive and valuable series of articles which should interest and help those for whom it is intended, Where so much is good it would be invidious to say that any article is the best, but the reviewer would particularly express his own appreciation of the articles on "Bunted Wheat" by Professor Biffen; "Fallentis Semita Vitae," by Mr. James Tabor; "Lucerne," by Mr. Primrose McConnell; and the two articles on "If I were a Farmer," by Mr. H. J. Skelton and A Doctor. All these offer much food for thought, and this is not to suggest that other articles are lacking in this respect, but we are all affected in different directions. Altogether the Essex Farmers' Union may be congratulated on such a clear token that the farmers of the county—and the Union's officers—are very much alive.

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ADDITIONS TO LIBRARY.

Agriculture, General and Miscellaneous.

American Joint Committee on Horticultural Nomenclature.—Standardized Plant Names. A Catalogue of approved scientific and common names of plants in American commerce. (562 pp.) Salem, Mass., 1923, \$5. [58(02).]

Boullanger, E.—*Distillerie Agricole et Industrielle*, Tome I. 3rd Edition. (460 pp.) Paris: J. B. Baillière et Fils, 1924, 10 fr. [663.1(02).]

Oregon Agricultural Experiment Station.—Bulletin 199:—Sulfur in Relation to Soil Fertility. (45 pp.) Corvallis, 1923. [63.167.]

Field Crops.

U.S. Department of Agriculture.—Bulletin 1180:—Field Experiments with Atmospheric Nitrogen Fertilizers. (43 pp. and 14 plates.) Washington, 1924. [63.1671.]

Leeds University and Yorkshire Council for Agricultural Education.—Bulletin 133:—Results of Experiments with Cereals, Potatoes, Swedes and Mangolds in Yorkshire, 1923. (13 pp.) Leeds, 1924. [63.31; 63.332; 63.512.]

Leeds University and Yorkshire Council for Agricultural Education.—Bulletin 132:—Varieties Trials of Potatoes in Yorkshire, 1923. (4 pp.) Leeds, 1923. [63.512.]

Australian Institute of Science and Industry.—Bulletin 26:—A Classification and Detailed Description of the More Important Wheats of Australia. (72 pp.) Melbourne, 1923. [63.311.]

U.S. Department of Agriculture.—Department Circular 305:—Electrochemical Treatment of Feed Wheat. (7 pp.) Washington, 1924. [537; 63.1951; 63.311.]

Long, H. C.—Garlic and Smut in Wheat. (18 pp.) Reprint from "Milling," Dec. 22, 1923. [63.311:198; 63.24; 63.259.]

Horticulture and Fruit Growing.

Dyer, B. and Shrivell, F. W. E.—*The Manuring of Market Garden Crops*. New Edition. (148 pp.) London: G. Street & Co., 1924, 1s. [63.51(04).]

Commercial Tomato Culture. By the Lea Valley Correspondent of the "Fruit Grower." (48 pp.) London: Ernest Benn, Ltd., 1924, 2s. 6d. net. [63.513.]

Morris, R. T.—*Nut Growing*. (245 pp.) New York and London: Macmillan, 1921, 1's. net. [63.41(d).]

Hooper, C. H.—*The Value of Hive and Wild Bees in the Production of Fruit*. (24 pp.) Wye: Agricultural College, 1924, 6d. [63.41(08).]

Plant Pests and Diseases.

Nebraska Agricultural Experiment Station.—Research Bulletin 25 :—A Study of the Environmental Conditions influencing the Development of Stem Rust (*Puccinia graminis tritici*) in the absence of an alternate Host. (52 pp.) Lincoln, 1923. [63.24.]

Live Stock and Feeding Stuffs.

Wood, T. B.—Animal Nutrition. (234 pp.) London : University Tutorial Press, 1924, 4s. 6d. [612.334(02).]

Cooper, W. and Nephews, Ltd.—Os Ovinos de Sangue Puro da Gra Bretanha. (58 pp.) Berkhamsted, 1924. [63.602.]

U.S. Department of Agriculture.—Miscellaneous Circular 12 :—A Hand-book for the Better Feeding of Livestock. (48 pp.) Washington, 1924. [63.6043.]

Michigan Agricultural Experiment Station.—Special Bulletin 120 :—The Microscopic Identification and Determination of the Specific Ingredients in Stock Foods. (31 pp.) East Lansing, 1923. [343.53(c); 63.60433.]

Medical Research Council.—Report on the Present State of Knowledge of Accessory Food Factors (Vitamins). 2nd Edition. (171 pp.) London : H.M. Stationery Office, 1924, 4s. 6d. [612.39(02).]

Veterinary Science.

The Veterinary Journal.—Special Foot-and-Mouth Disease Number, March, 1924. London : Baillière, Tindall & Cox, 2s. [619.2(d).]

Poultry.

Brown, E. T.—The Poultry-Keeper's Text-Book. (320 pp.) London : Ward, Lock & Co., 1924, 6s. [63.65(02).]

Benjamin, E. W.—Marketing Poultry Products. (325 pp.) New York : John Wiley; London : Chapman & Hall. 1923, 15s. [63.65(02); 63.741; 63.753.]

Smith, E. Bostock.—Profitable Poultry. (40 pp.) The Author, "Heaslands," Hayward's Heath, Sussex, 1924, 1s. [63.651(02).]

U.S. Department of Agriculture.—Bulletin 1228 :—Results of Experiments with Miscellaneous Substances against the Chicken Mite. (10 pp.) Washington, 1924. [59.169.]

Economics.

Meakin, W.—Where Farming Pays, and Why. (64 pp.) London : Iliffe & Sons, 1924, 1s. [334(489).]

(A short account of the co operative organisation of agriculture in Denmark.)

Bogart, E. L.—Economic History of American Agriculture. (183 pp.) New York and London : Longmans, Green & Co., 1923, 6s. [63.73.]

Spencer, A. J.—The Agricultural Holdings Act, 1923, with Explanatory Notes and General Forms. 7th Edition. London : Stevens & Sons, 1924, 10s. 6d. [347(a).]

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MAY, 1924.

NOTES FOR THE MONTH.

THE Minister of Agriculture, on 14th April, introduced into Parliament a Bill for the better regulation of agricultural wages.

The Agricultural Wages (Regulation) Bill. The Bill was to come up for second reading after the Easter recess. Farmers interested can obtain a copy of the Bill through a bookseller or from H.M. Stationery Office, price 6d. The following is a brief outline of it:—

Provision is made for the establishment of a Wages Committee for each county (or group of counties) and of an Agricultural Wages Board, each comprising representatives of employers and workers in agriculture in equal proportions, with the addition, in the case of the Committees, of an independent Chairman elected by the Committee and, in the case of the Board, of independent members appointed by the Minister. The Chairman of a District Committee will not have the right to vote unless he is so empowered by the Committee.

The County Committees are to be charged with the duty of fixing minimum rates of wages for the various classes of agricultural workers in their areas, but such rates will not become operative unless and until confirmed by the Wages Board. Before any rate is fixed, either by the Board or a Committee, public notice of the rate must be given, and objections may be lodged to it. In the event of a Committee failing to fix minimum rates within two months of its establishment, the Board may request them to fix such rates and, failing compliance with this request, the power of fixing the rates devolves upon the Board, who may also secure the cancellation or revision of any rate previously confirmed by them or the fixing of a minimum rate for any special class of workers.

Minimum rates confirmed by the Board will be legally binding on all employers in agriculture in the areas concerned and will be enforceable, if necessary, by official proceedings on the workers' behalf. The only exceptions to the minimum rates will be those in which the Wages Committees decide to grant permits

exempting workers from the operation of the rates on account of physical injury or mental deficiency or other infirmity.

The Minister may, in accordance with the provisions of the Bill, make Regulations empowering the Committees and the Board to define the allowances in kind which may be reckoned as part payment of wages and to define the employment which shall be treated as overtime employment for the purpose of the minimum rates.

In the case of workers who are employed on piece work for which no minimum piece rate of wages has been fixed, the Wages Committees may investigate any complaints which are made by the workers and order the payment by the employer of such amount by way of arrears of wages as appears to them to be necessary to bring the worker's earnings up to the level of the minimum wage.

The provisions of the Bill differ from those of the Corn Production Act of 1917 mainly in respect of the functions of the District Committees which, under that Act, had a purely advisory capacity, but are now to be charged with the specific duty of fixing minimum rates of wages for their areas. The constitution of the Committees varies also in so far as the independent members formerly appointed by the Minister on each Committee are replaced by a Chairman elected by the representative members. The provision of the old Act restraining the wage-fixing authority from fixing rates below a specified amount (which for the purpose was 25s.) is omitted from the new Bill, and the Committees are simply enjoined to secure for able-bodied men such wages as are adequate to promote efficiency and to enable a man in an ordinary case to maintain himself and his family in accordance with such standard of comfort as may be reasonable in relation to the nature of his occupation.

* * * * *

THE Agricultural Returns Bill which is now before Parliament passed its second reading in the House of Lords on 10th April.

Agricultural Returns Bill.

This Bill is intended to give the Ministry the compulsory powers to require these returns which it had under the Corn Production Act of 1917, but which disappeared when that Act was repealed.

The compulsory powers are needed not because they will be put into force (except in very rare instances) but because they will give the Ministry and in particular the Ministry's local officers the necessary support in collecting particulars from persons who do not realise the importance both to Parliament

and to the industry of obtaining information on which opinions can be formed as to the magnitude, progress and productive capacity of the different branches of agriculture.

The value of these returns cannot be questioned. They are the basis of all discussion on agricultural policy, and afford the only reliable evidence of the dimensions of the industry, and of the changes in cultivation and in the numbers of livestock. Information on these points is very essential to any adequate estimate of the economic conditions of agriculture.

While the large majority of farmers fully recognise the value of these returns and endeavour to give complete and accurate information, there are some who are careless and indifferent. In a proportion of cases the return is obtained only after repeated applications and sometimes a visit from the Ministry's Crop Reporter, and in a small minority of cases the occupier declines to make a return.

These cases of failure to furnish the returns promptly add materially to the cost of collection, and delay publication of the results. In this connection, it is of interest to remember that the principle of the Bill has received the support of the principal Agricultural Organisations. At a Conference of the National Farmers' Union of England and Wales, the National Farmers' Union of Scotland, and the Irish Farmers' Union held in April of last year the following resolution, which had been passed by the General Purposes Committee of the first-named union, was endorsed:—

“ That this Council of the National Farmers' Union, recognising the great value of accurate statistical and economic information to the industry in all its branches, informs the Minister of Agriculture that it would welcome the introduction of a measure in Parliament to put upon a sound basis the annual Agricultural Statistics for England and Wales, provided that such a measure contained due guarantee that the information so given by individual farmers would not be disclosed or used for any other purpose than the compilation of these returns.”

The Bill includes a clause to meet the point raised in the last clause of this resolution. The proposal to make the returns compulsory has also been submitted to the Agricultural Advisory Committee, the Council of Agriculture, and the Council of Agriculture for Wales.

Reference may be made to one or two points to which exception has been taken. For instance, complaint is sometimes made in

regard to the request included in the return for 1921 and 1923 in respect to the number of workers employed. The only information as to the number of men employed in agriculture apart from this is contained in the Occupation Census, which is only taken every ten years and is issued long after the period to which it refers. The particulars given in the returns are available promptly and provide information on the current position, while they are more valuable in some respects than the Census figures, as they give the number of persons employed as stated by the occupier, whereas the Census figures depend on how the person himself describes his occupation. Information in regard to the number of persons employed is obviously of fundamental importance in any consideration of the economic position of agriculture.

Exception has been taken to the clause which provides that a person who fails to make a return, or who makes a false return, shall be liable to a fine not exceeding twenty pounds. Proceedings under this clause would hardly be instituted except in really flagrant cases, and where a conviction followed, the amount of the fine would be fixed by the Court.

Criticism is sometimes directed against what is called the complexity of the annual return. The return, however, only asks for details which are or should be well within the knowledge of the occupier, such as the area under different crops or the number of live stock on the holding. Apart from this, details are necessary because agriculture is not a single industry but comprises a number of different industries, while agricultural practice varies considerably in different districts. A return in detail is really essential if the interests of all classes of agriculturists are to be fairly considered.

The Ministry moreover is continually being pressed to furnish or to collect statistical information on a number of points in regard to which reliable data are at present lacking. This is particularly the case with regard to fruit and poultry.

In the case of fruit, an attempt was made last year to get information which would enable estimates of fruit production to be made. There is a strong demand for this in the trade, although individual growers in some cases complained of the trouble involved. In the same way, two years ago when poultry statistics were collected some persons regarded it as unnecessary. The National Poultry Council and other poultry interests on the other hand, complain that the information collected in regard to their industry is insufficient.

THE Ministry's annual report on the agricultural production of England and Wales in 1923 has just been published.

**Agricultural
Production
in 1923.**

In addition to estimates of the yield of the main crops, figures for which are given by counties, the Report includes, as last year, estimates of the production of early potatoes, carrots, and other minor crops. A new feature is the inclusion of estimates, made by the Ministry's Inspectors and Horticultural Organisers, of the production of the various kinds of fruit. Estimates of the production of meat, milk, butter, cheese, poultry, eggs and wool are also included, so that the Report deals with practically the whole output from the farms of the country.

The approximate value of the products sold off the farms of Great Britain for consumption has again been calculated, and the figures are given separately for each of several main groups of commodities for 1922 and 1923.

In continuation and extension of the information published in 1922 as regards the average characteristics of holdings of different types, two further types of holdings have been added, viz., farms on which potatoes are an important crop, and large arable farms of Norfolk. For ease in comparison the acreage of crops and number of live stock have been calculated per 1,000 acres of crops and grass in each case, and the differences between the general run of arable farms in Norfolk, arable sheep farms, potato farms, mixed farms of various sizes, and grass farms devoted to milk production and sheep respectively are brought out clearly. A table is also given showing the number of regular workers employed per 1,000 acres on each type of farm.

Special returns have been furnished by a number of farmers of the output from their farms. These returns have been tabulated according to the type of farm, and afford interesting data of the average sales from mixed farms of different sizes in the eastern and western half of the country respectively and from potato farms, together with the quantity of milk produced on dairy farms and the quantity of eggs and poultry sold off poultry farms.

The Report, which forms Part II of the Agricultural Statistics, 1923, is published by H.M. Stationery Office and may be purchased through any bookseller, price 1s. 1d., or direct from H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2, price 1s. 1½d. post free.

ATTENTION is directed to the possibility of obtaining assistance under the Trade Facilities Acts in respect of large undertakings

**Assistance to
Agriculture under
the Trade
Facilities Acts.**

which it may not be possible to assist under the scheme of loans to agricultural co-operative societies which is administered by the Ministry.

Under the terms of the Trade Facilities Acts the Treasury may guarantee the interest and repayment of loans raised in connection with the carrying out of any capital undertaking, or for the purchase of articles manufactured or produced in the United Kingdom which are required for the purposes of any such undertaking, if they are satisfied that the application of the loan in the manner proposed is calculated to promote employment in the United Kingdom.

Agricultural undertakings which might be eligible for consideration are sugar-beet factories, dairy factories or milk depots, large bacon factories, live stock auction marts, fruit markets or other large-scale undertakings dealing with agricultural produce.

Under the Trade Facilities Acts the Treasury can only guarantee loans; they have no power to make a loan of any kind. The guarantee cannot be used for the provision of working capital, nor for the purpose of extinguishing existing liabilities.

Application should be made to the Trade Facilities Advisory Committee, 16 Finsbury Circus, London, E.C.2. who will have to be satisfied on the following points, among others:—

1. That the undertaking can raise the rest of the money (apart from the guaranteed loans) needed to carry through the scheme to completion and equip it with working capital.
2. That the scheme is well thought out and has good prospects of commercial success.

* * * * *

It is announced that the Stationery Office are to publish a cheap edition of the Reports of the Departmental Committee on Distribution and Prices of Agricultural Produce, which sat under the Chairmanship of the Marquess of Linlithgow during the whole of last year. The Committee submitted four interim reports, dealing with Milk and Milk Products, Fruit and Vegetables, Meat, Poultry and Eggs, and Cereals, Flour and Bread, together with a Final Report, and these reports examine in

**The Linlithgow
Committee.**

detail the distributive system in the case of each group of products. The reports are to be issued bound in one volume, at a price of 3s. 6d. net, and are expected to be on sale early in May.

* * * * *

EVER since the discovery that Charlock could readily be destroyed in a corn crop by spraying with a solution of copper sulphate—without real injury to the corn—it has been the hope of farmers and research workers that chemical means would be found to enable them to combat other weeds.

Destruction of Weeds by Spraying.

The Ministry is encouraging research in this direction. A good deal is already known, and in general terms it may be said that it has been found that the spraying of crops with chemical substances, more especially with sulphate of copper (bluestone) and sulphate of iron, is exceedingly useful in destroying weeds. The destruction of Charlock (*Brassica Sinapistrum*, Boiss.) in corn crops by spraying is dealt with in the Ministry's Leaflet No. 63, the first edition of which was issued just over 24 years ago. Solutions of the sulphates of copper and iron, however, may be employed against other weeds, some of which may be destroyed and others crippled. Persicaria or Red-shank (*Polygonum Persicaria*, L.) and Spurrey (*Spergula arvensis*, L.) may be killed by spraying with 4 and 5 per cent. solutions of copper sulphate respectively; while the following weeds are more or less crippled and seeding largely prevented by spraying with a 5 per cent. solution of copper sulphate, or a 15 per cent. solution of sulphate of iron:—

Poppy (<i>Papaver</i> sp.).	Dandelion (<i>Taraxacum officinale</i> , Wigg).
Corn Cockle (<i>Agrostemma Githago</i> , L.).	Perennial Sow Thistle (<i>Sonchus arvensis</i> , L.).
Black Bindweed (<i>Polygonum Convolvulus</i> , L.).	Cornflower (<i>Centaurea cyanus</i> , L.).
Dock (<i>Rumex</i> sp.).	Thistles (<i>Cnicus</i> sp.).
Groundsel (<i>Senecio vulgaris</i> , L.).	Coltsfoot (<i>Tussilago Farfara</i> , L.).

Yellow rattle (*Rhinanthus Crista-galli*, L.) may in some cases be materially reduced by dressing the infested meadows with salt at the rate of 5 or 6 cwt. per acre as soon as the seedlings appear in spring, usually about the end of April. In one case 2 cwt. per acre of dusty nitrolim applied in dry weather at the end of May proved effective.

Notes on the destruction of Hoary Pepperwort (*Lepidium Draba*, L.) were given in the April issue of this *Journal* (p. 29).

Spraying with sulphate of ammonia (1 to 2 cwt. in 60 gal. of water per acre) has also been tried. The following plants are said to have yielded to this treatment:—

Corn Buttercup (*Ranunculus arvensis*, L.).

Speedwells (*Veronica* sp.).

Charlock (*Brassica Sinapistrum*, Boiss.).

Wild Radish (*Raphanus Raphanistrum*, L.).

In this connection it is important to bear in mind that most cultivated crops may also be seriously injured by this spray, with the exception of wheat and oats and possibly barley and rye. It should not be sprayed on crops other than cereals, and even then not when “seeds” have been sown with the corn.

The Woburn experiments many years ago showed that the Wild Onion (*Allium vineale*, L.) was largely reduced, without injury to the soil for a subsequent corn crop, by spraying with a 5 per cent. solution of pure carbolic acid.

Among other substances which have been used as weed killers in various ways are arsenic compounds, bisulphate of soda, kainit, sulphuric acid, hydrochloric acid, nitrate of copper, and chlorate of soda.

These brief notes are given for the guidance of those who would like to try spraying this year. All particulars available in connection with any weed or substance mentioned will gladly be sent on application being made to the Ministry.

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A DEPUTATION from the British Sugar Beet Society, Limited, was received at the House of Commons on 11th April by Mr. Noel

**Deputation from
British Sugar
Beet Society.**

Buxton, the Minister of Agriculture and Fisheries, and Mr. Graham, the Financial Secretary to the Treasury. The deputation stated that in order to preserve the existing factories and to provide new sugar factories, without which the farmer would have no market for his beet, some form of stabilisation to the infant sugar beet industry was essential, and they urged the Government in the interests of British agriculture to consider favourably the following three proposals with a view to maintaining and developing the industry on sound and permanent lines:—

- (1) The assistance to the sugar beet industry to be guaranteed by the State for a definite term of years. Such a guarantee would involve the payment of a subsidy to the industry in the event of the import duty in any year being less than the assistance secured under the guarantee.

- (2) The Trade Facilities Act Advisory Committee, in the altered situation arising from the foregoing proposal, to be empowered to recommend guaranteed advances to sound beet sugar factory schemes, on such conditions and on such terms of repayment as will not discourage the raising from private sources of the balance of the necessary capital on the security of shares.
- (3) A grant to be made from the Development Fund to the Society for the promotion and maintenance of a School for the Sugar Industry, one of the main factors of the success of the Beet Sugar Industry, in Continental countries. Such a school, in conjunction with the Universities and existing factories, would train technical experts and foremen for future factories.

Mr. Buxton in reply said that the representations of the Society would receive the careful consideration of the Government. He could not, however, give a definite reply at the moment as to the Government's intentions as that would be anticipating the Budget statement. He could say, however, that the Government recognised the importance of practical encouragement to any new industry which offered reasonable chances of success, and that they would carefully consider any schemes which were put forward with regard to this particular new industry.

Mr. Graham explained the nature of the regulations of the Trade Facilities Act Advisory Committee, and said that everything would be done to make the conditions as elastic as possible. He also promised to convey to the Chancellor of the Exchequer the points raised by the deputation.

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THE Electro-Culture Committee recently presented to the Minister of Agriculture its Sixth Interim Report, dealing with its work during 1923.* Previous work of

Electro-Culture Investigations.

the Committee has been directed chiefly to ascertaining (1) the type of electrical apparatus

most suitable for the production of high-tension discharge, (2) the maximum effective strength of current, and (3) the effect of the discharge applied under field experimental conditions to spring-sown cereals. Regarding (3) the Committee have shown that, on the average, an increase of 20 per cent. may be expected when certain spring-sown cereals are subjected to the discharge. It may be recalled that a very striking result was obtained in 1922 from pot-culture experiments, an increase of 118 per cent. in yield of grain being obtained by electrification for the second month of the growing season only, the current

* Copies of this Report can be obtained from the Secretary of the Committee, Mr. W. R. Black, B.Sc., Ministry of Agriculture, 10, Whitehall Place London, S.W.1.

being applied for six hours daily. In view of this result the Committee decided to discontinue, temporarily, its field work, and to concentrate on pot-culture, small-plot, and laboratory work for a time, the object being to ascertain the most suitable periods and hours of the day for the discharge. In 1923, therefore, pot experiments were carried out at Rothamsted, small-plot experiments at Rothamsted and Lincluden (Dumfries), and laboratory work at the Imperial College of Science and Technology.

In the pot experiments at Rothamsted in 1923 the best results were given by electrification during the second month only, and in this case electrification for six hours daily was more effective than electrification for one hour daily. This result confirmed that obtained in the pot-culture experiments in 1922, but the increased dry weight of grain in 1923, viz., 24 per cent., was not nearly so marked as that in 1922, viz., 118 per cent.

In the small-plot experiments in 1923 at Lincluden electrification for one month only gave better results than electrification for the whole three months of the growing season, there being little to choose between the individual months in this respect. The small-plot experiments at Rothamsted had to be given up, as the crop failed owing to the selection of new ground and to the abnormal season.

The general results from the pot-culture and small-plot experiments of 1923 confirm, therefore, the results of the pot-culture experiments in 1922, viz., that electrification of spring-sown cereals for one month is more effective than electrification for three months; and there is some evidence to show that electrification for the second month of the growing season is most effective. In the second month's electrification the effect of the discharge seems to be a differential one, affecting grain weight rather than the total weight of plants.

The laboratory experiments have been concerned with the after-effect of the current. The after-effect from one hour's discharge has been found to be greater than that of three hours' discharge, and the after-effect from half-an-hour's discharge has been found to continue for nine hours.

Work has also been carried out on the effect of ordinary atmospheric electricity. The results obtained so far give some indication of a beneficial effect on plant growth of atmospheric electricity.

In the present year the Committee is confining its programme to pot-culture, small-plot, and laboratory work, as in 1923, but

additional investigations will deal with the effect of the discharge over smaller periods than one month, and the effect of varying the effect of the current, since no knowledge is yet available of the minimum strength of current that is effective. In 1925 the Committee hopes to resume field work, in order to test, on various soils and under different climatic conditions, the results obtained from the pot-culture and small-plot experiments in 1922-23-24.

* * * * *

For the first time since October last year, the index number of prices of agricultural produce shows a decline, the general level of prices during March being 57 per cent. above that in the corresponding month of the years 1911 to 1913, as compared with 61 in February. A fall of 4 points between February and March also occurred last year and, on the average, prices in 1924 are following much the same course as in 1923.

In the following table are shown the percentage increases monthly since January, 1920 :—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING
MONTH IN 1911-13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	61
March ...	189	150	77	59	57
April ...	202	149	70	54	—
May ...	180	119	71	54	—
June ...	175	112	68	51	—
July ...	186	112	72	53	—
August ...	193	131	67	54	—
September	202	116	57	56	—
October ...	194	86	59	51	—
November	193	79	62	53	—
December	184	76	59	56	—

Alterations in corn prices were small, wheat showing an advance of 2d. per cwt. and barley and oats decreases of 1d. and 2d. respectively per cwt. The index number for wheat has advanced, and that for oats has fallen, by 2 points, while in spite of the decline in barley prices the index number has advanced, owing to the relatively greater decrease in prices in the pre-war years.

Potatoes have been falling slowly throughout the month, but they have far from lost the advance recorded during February,

and the average during the month, 214s. 6d. per ton, is 173 per cent. in advance of pre-war prices and more than three times the price obtainable in March last year. Meadow hay was rather dearer in March than in February, and this, combined with a slight fall in the average prices in the corresponding months in 1911 to 1913, suffices to raise prices during March to slightly over their pre-war level.

Prices of fat stock are usually rising at this season of the year, and for this reason cattle and pigs, although practically unaltered in value in March as compared with February, show a slight decline on the month in relation to pre-war prices, while the reduction from 14d. to 13½d. in the average price of sheep is magnified, through the same cause, to a fall of 11 points in the index number. Fat sheep and pigs are distinctly cheaper than in March last year, and, although sheep remain rather dearer than most other kinds of produce, pigs are now cheaper, in comparison with pre-war prices than any agricultural product except hay.

The trade in store stock is still so greatly hampered by foot-and-mouth disease regulations and restrictions as to render the average prices which may be calculated not fully representative of values, but so far as figures are available they indicate a substantial increase in the cost of dairy cattle, amounting to about 50s. per head on the month; the rise in the index number must be discounted to some slight extent, however, as prices customarily fall slightly at this time of year. Store cattle also show a slight advance, both actually and relatively, but store sheep and swine, although a shade dearer on the month, have not risen to their customary extent and the index numbers in consequence show a fall.

The main contributory factor to the decline of 4 points in the general index number is the fall in the contract prices of milk, which, under the scheme of the National Farmers' Union, was delivered at 1s. 5d. per gallon during March as compared with 1s. 8d. during February. This fall is modified to some extent by lesser reductions in areas where the scheme is not in operation but average prices have fallen from 87 per cent. above pre-war level in February to 71 per cent. above in March. Butter has also declined by a greater amount than is usual at this season, but cheese prices show no material alteration. Eggs declined sharply on the month, the fall being relatively rather greater than before the war.

Index numbers of different commodities during recent months and in February, 1913, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

Commodity.	1923.			1924.		
	Mar.	Nov.	Dec.	Jan.	Feb.	Mar.
Wheat ...	27	22	33	34	44	46
Barley ...	8	25	27	34	43	45
Oats ...	36	24	30	38	41	39
Fat cattle ...	54	47	49	56	54	52
Fat sheep ...	94	77	72	87	75	64
Fat pigs ...	77	47	43	43	34	33
Dairy cows ...	58	57	—	51	48	64
Store cattle ...	31	25	—	35	39	41
Store sheep ...	92	88	—	91	89	85
Store pigs ...	136	75	—	63	50	45
Eggs... ..	55	92	86	85	75	68
Poultry ...	81	58	77	60	52	59
Milk	87	75	90	87	87	71
Butter	70	64	68	68	71	63
Cheese	95	73	71	76	72	71
Potatoes ...	—12*	80	91	129	170	173
Hay	42	—1*	0	—1*	—1*	5

* Decrease.

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THE Devonshire Committee's agreement, which was due to expire on 25th March last, has been extended, with minor amend-

Conciliation Committees in Agriculture.

ments, up to 28th June, and will continue to operate until Michaelmas, unless either side asks for reconsideration. The rate for adult male workers is 30s. for 51 hours, and

harvest work is to be paid for at the Sunday overtime rate (10d. per hour).

The Committee for Lancashire met on 7th March and decided that the terms of the existing agreement should remain in operation for a further 12 weeks, *i.e.*, up to the end of May. The rates are:—*Southern Area*—Special Class Workers, 35s. for customary hours; Other Workers, 32s. 6d. *Northern Area*—Special Class Workers, 37s. 6d. for customary hours; Other Workers, 35s. *Eastern Area*—Special Class Workers, 40s. for customary hours.

The Shropshire Committee has also decided to make no change in rates of wages for the time being, the current agreement for a rate of 30s. for a guaranteed week of 54 hours being extended up to the 1st November. There is a provision that harvest work after 6 p.m. from Monday to Friday, and after 2 p.m. on Saturday, should be paid for at 10d. per hour.

* * * * *

BRITISH



EMPIRE

EXHIBITION.

Agricultural Research Exhibits.—The agricultural research exhibits at the British Empire Exhibition have already been briefly described in this *Journal*.^{*} The exhibits are staged in a large gallery in the Government Pavilion—an imposing building guarded by six massive stone lions—an illustration of which was included in the issue of this *Journal* for January last. The position of the Government Pavilion is shown in the plan of the Exhibition on the extreme right of the plan. A bird's-eye view of the whole Exhibition faces this page.

The exhibits are arranged in cases in the following groups :—

I. The Soil	Cases A and B.
II. Plant Improvement	„ C. D. E.
III. The Health of Plants : Diseases and Insect Pests	„ F. G. H. I. J.
IV. Horticulture and Farming	„ K. L. M.
V. Animal Improvement	„ N. O. R. S.
VI. Fertility of Domestic Animals	Case Q.
VII. Animal Nutrition	„ P.
VIII. The Health of Animals	Cases T. and U.
IX. Agricultural Economics	Case V.

The exhibits, which have been organised by the Ministry in collaboration with the Board of Agriculture for Scotland, are confined to research and have been supplied by various Research Institutions in Great Britain.

Agricultural research presents difficulties to the exhibitor; its range is immense, and even if the selection be confined to aspects of special practical value the choice is still embarrassing. The selection that has been made, has been made for the most part by researchers themselves in an attempt to outline, as it were, the story of work which is now being carried on at research institutions and laboratories in England, Scotland and Wales. To many this story will be quite new.

A very full account of the exhibits has been published in the form of a guide, which contains a preface by Sir A. D. Hall, Chief Scientific Adviser to the Ministry, and extends to 66 pages. Copies of this guide can be obtained at the Exhibition, price 6d. It should prove of great immediate interest to farmers, and serve as an indication—though by no means a complete one—of the many directions in which research is striving to assist them.

^{*} March, 1924, pp. 1116-19 ; April, 1924, pp. 3-4 and 9-14 ; and previous issues.

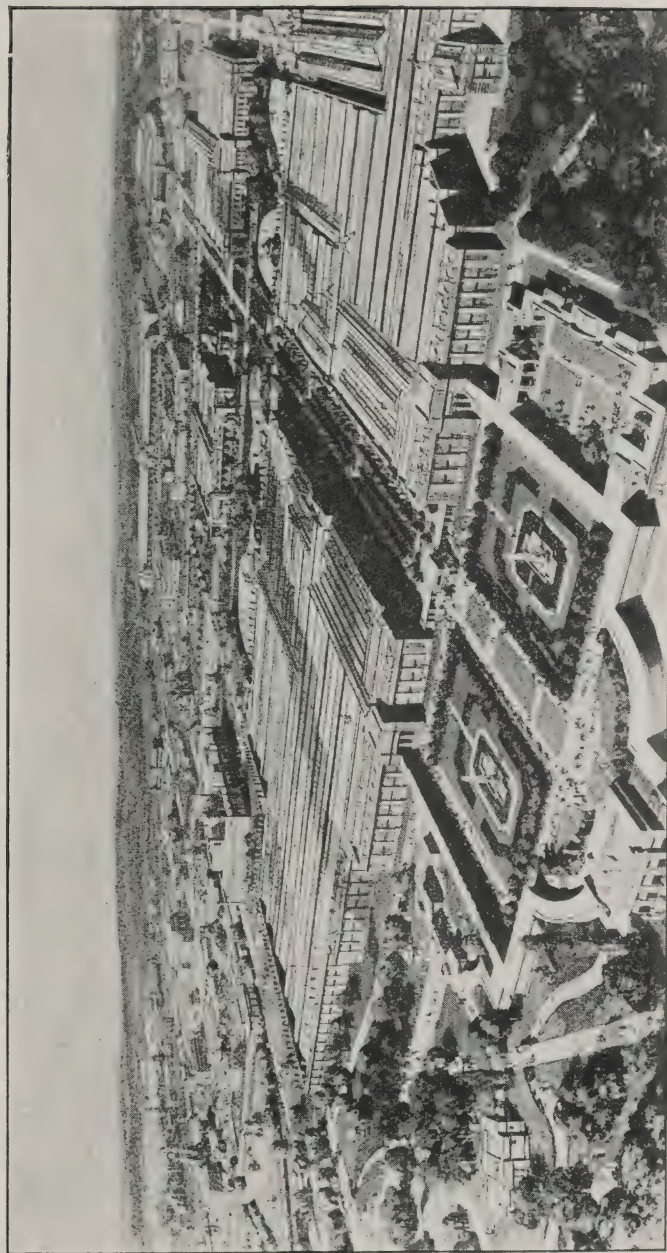


FIG. 1.—British Empire Exhibition—Bird's-eye view.

By Courtesy of the British Empire Exhibition.

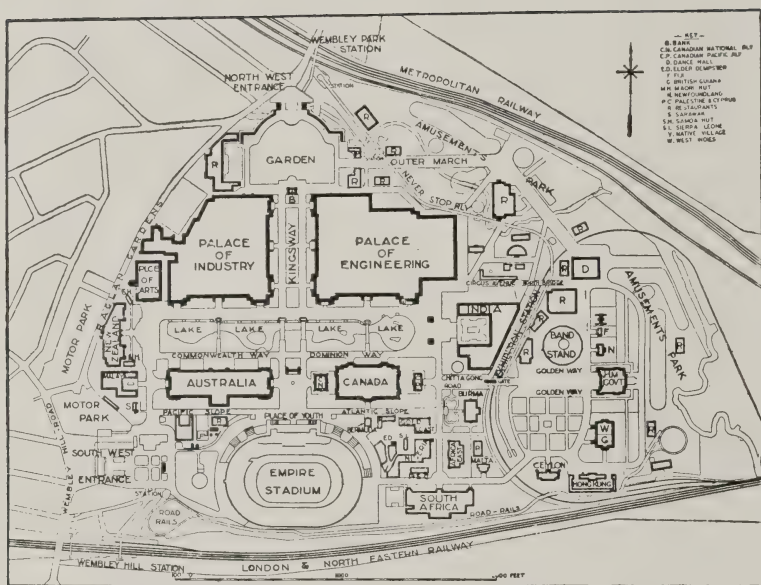


FIG. 2.—British Empire Exhibition—Plan.

By Courtesy of the British Empire Exhibition.

Films dealing with agricultural machinery, the production of home-grown beet sugar, clean milk production, and the improvement in British wheats for bread-making will be shown in the Government Pavilion during the course of the Exhibition.

Arrangements have been made for visitors to be conducted round the Gallery at intervals during the day, when short informal talks will be given by Mr. K. B. Williamson, M.A., Dip. Agric. (Cantab.), with the object of explaining the exhibits in a popular manner. The times will be shown on the notice board at the entrance to the Gallery. Arrangements will also be made as desired for the exhibits to be explained in a more detailed manner to parties of agriculturists and agricultural students.

* * * * *

THE decline in horse breeding, as shown in the Agricultural Returns last June, when the number of stallions used for

**Licensing of
Stallions under the
Horse Breeding
Act, 1918.**

service was returned as 5,459 as compared with 6,074 in 1922, and the number of foals as 66,323 as compared with 83,890 in the previous year, is further emphasised by the records available up to 31st March

last as to the number of stallions licensed by the Ministry for this season under the Horse Breeding Act, 1918.

While some further applications for licences may be received during the next two months the number issued up to 31st March last is only 1,692. The comparative figures for the last three service seasons are 3,113 in 1921, 2,747 in 1922 and 2,176 in 1923. The decrease in the number of licences issued is very marked in the case of Shire Stallions, and shows a reduction this season of nearly 55 per cent. on the figure for the 1921 season.

The revival of the award of grants by the Ministry to Heavy Horse Societies will, it is hoped, tend to encourage the travelling of more stallions than would otherwise be the case, but it is not anticipated that the effect of these grants will increase the number of stallions licensed this season.

After the close of the service season the Ministry will publish particulars, according to breeds, of the total number of licences issued, but the following information that is now available may be of interest to horse breeders:—

<i>Service Season.</i>				1921.	1922.	1923.	1924.
Shires	...	...	...	2,157	1,845	1,379	975
Other Heavy Horses	...	...	...	495	428	367	309
Light Stallions (including Ponies)				461	474	430	408
TOTAL	...	...	...	<u>3,113</u>	<u>2,747</u>	<u>2,176</u>	<u>1,692</u>

SOIL IMPROVEMENT.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
Rothamsted Experimental Station.

Soil improvement may be attempted for two reasons: (1) to enable the soil to carry larger crops than before; or (2) to alter it somewhat so that it may carry crops it has not previously borne. Almost every soil has already the capacity of producing something, even if it be only ragwort and gorse. These, however, are not crops the farmer wants, and therefore he alters the soil so as to make it yield something of commercial value.

It is impossible to lay down any hard and fast rules as to soil improvement; an intelligent appreciation of the position is perhaps the chief necessity, though of course it may be desirable to seek the help of the County Organiser in running down some special factor that is causing trouble. One important point that works always in favour of the farmer is that the requirements of the plant are not rigidly fixed; the plant, like other living things, can adapt itself to some extent to its surroundings, and in particular the different varieties of the same crop differ in their requirements so that by suitable selection among these varieties it is possible for the farmer to simplify his problem a good deal. There is no form of wastefulness so bad as trying to grow varieties not well suited to the farm.

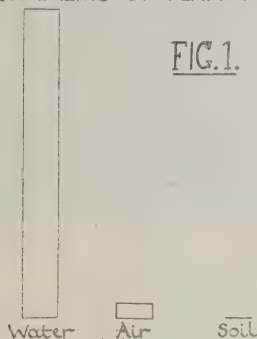
A second important factor in the situation is that the soil is only one of the partners in the concern, the other being the weather. The soil, the weather, and the crop should on the perfect farm all fit each other as a key fits a lock. Unfortunately in practice there is always some misfitting which it is the object of soil improvement to try to overcome. The result of the large part played by the weather is that there is no such thing as a perfect soil type good under all conditions. The utmost that can be expected is that the soil shall suit the climate. A soil property may be a serious defect in one set of weather conditions and a great advantage in others.

This is well illustrated by the following facts giving particulars of two soils one of which is a hopeless waste, while the other is fertile:—

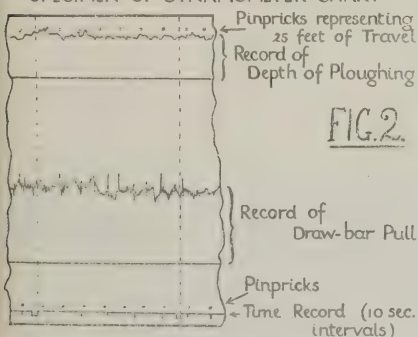
<i>Coarse Sand.</i>	<i>Clay.</i>	<i>Location.</i>	<i>Annual Rainfall.</i>	<i>Value for Agriculture.</i>
93·7	Nil	Anglesey	35 in., water level only 3 or 4 ft. down	Good. Fairly prosperous small holdings—potatoes and carrots.
62·4	0·5	Wangford, Suffolk	About 23 in., water level very deep down	Absolutely nil. Waste land.

Both soils are very similar in type and both are poor; indeed the Anglesey soil on analysis seems to be the poorer of the two. The great difference between them lies in their water supply; one has less than 23 inches in the year and has no available reserve in the subsoil, the other has more than 35 inches and has a permanent supply 3 or 4 feet below the surface. The real defect of both soils is their inability to retain water; this is so serious a matter in the dry conditions at Wangford that it renders the soil absolutely useless for farm purposes; but it is a great gain in the wetter conditions of the Anglesey sand because it ensures that the excess of water can easily get away.

REQUIREMENTS OF PLANTS



SPECIMEN OF DYNAMOMETER CHART



LOSSES OF FERTILISER CONSTITUENTS FROM SOIL OF BROADBALK WHEAT FIELD



Water Supply.—Probably the most important thing to put right is the water supply to the plant. In many parts of the Empire this is done by irrigation; in Britain this method is not usually possible excepting in regard to meadows in the Severn valley and other parts of the south-west of England where flooding is a recognised and valuable procedure. In low-lying fen and silt regions of the eastern counties and in some

of the marshes of the south of England, especially Romney Marsh, all the advantages of irrigation are obtained by regulating the outflow from the ditches, thereby raising or lowering the water level in the soil as may be desired. Indeed this underground watering or sub-irrigation is one of the best ways of putting water on to the land. These direct methods are, however, the exception in Great Britain and not the rule, and other methods have to be adopted. The importance of the problem is illustrated by Fig. 1, the columns of which show the respective needs of the plant for water, air, and manure. The amount of food the plant takes from the soil when compared with the water is so small that it cannot be shown by a column but is indicated only by a line. If the food requirement of a crop were represented by a column 1 in. high the water requirements would need a column about as high as Nelson's column in Trafalgar Square.

The question of water supply is of special urgency in the eastern counties owing to the limited rainfall there. As often happens in British agriculture, the difficulty has been to a considerable extent obviated by the farmers, and indeed made to serve their ends. Here it is done by growing crops for seed, for which a low rainfall is desirable, since long experience has shown that high quality is best obtained in dry conditions.

However, the whole farm cannot be run for seed production purposes, and fodder crops are required for which a sufficient supply of water in the soil is essential. Over most of the country the water supplied by the rainfall would usually be sufficient if it could be kept in the soil as long as it is needed. Unfortunately the water is liable to be lost into the air by evaporation and into the subsoil by percolation. At Rothamsted on an average the losses from these two causes are about equal; about half the rainfall being lost by drainage and half by evaporation, but the proportion varies from month to month and from year to year. Thus on an average for the 52 harvest years, 1871-1922, the figures for an uncropped soil have been:—

	<i>Sept.</i>	<i>Oct.</i>	<i>Nov.</i>	<i>Dec.</i>	<i>Jan.</i>	<i>Feb.</i>	<i>Mar.</i>	<i>Apr.</i>	<i>May</i>	<i>June</i>	<i>July</i>	<i>Aug.</i>
Rainfall (in.)	2·3	3·1	2·8	2·8	2·4	2·0	2·1	2·0	2·0	2·3	2·7	2·7
Per cent. lost by—												
Drainage	28	31	72	84	85	75	37	34	24	25	25	25
Evaporation	72	69	28	16	15	25	63	66	76	75	75	75

The variation for individual years has been considerable, as is illustrated by the very hot dry 1921 and the cold unpleasant 1922.



FIG. 4.—Field 40, Garforth, ploughed out from old pasture 1917-18. (Looking North).
Date photographed, September, 1920. Barley Crop.

Right.—Plots 14 and 15 of old series of grass plots laid down 1898-99. Plot 14.
6 tons of quick lime per acre 1898. Plot 15, 6 tons of gas lime per
acre 1898.

Left.—Plots 11 to 13 of old series of grass plots, which did not receive lime. The
white flowers are Yarrow, and the grass is Bent (*Agrostis stolonifera*).



FIG. 5.—Field 40, Garforth, ploughed out from old pasture 1917-18. Date photographed.
February, 1921. First ploughing after harvesting the 1920 Barley Crop.
Other particulars as for Fig. 4.

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<i>Sept.—August</i>	<i>Average 52 years 1871–1922</i>		1921	1922		
Rainfall (in.)	...	29.24	...	16.09	...	29.78
Per cent. lost by—						
Drainage	...	49.5	...	34	...	47
Evaporation	...	50.5	...	66	...	53

In the Soil Physics laboratory at Rothamsted careful studies are being made to find out the inner mechanism of these losses, and if possible how they can be reduced. Special cylinders have been filled with various types of soil and exposed to the weather, and measurements are taken to discover the movements and losses of water that occur. As yet there is little to give in the way of advice beyond the fact already known in a general way, but made definite by many measurements at Rothamsted, that surface cultivation, farmyard manure and green manuring all reduce loss of water and so serve to maintain a sufficient supply in the soil. At Rothamsted the plots receiving farmyard manure contain in a dry spell some 5 per cent. or more moisture in excess of those not so supplied.

Soil Aeration.—Closely connected with the water supply is the air supply for the roots. Everyone knows that roots suck up water and food from the soil; it is not so well known that they breathe, and that if they are suffocated through lack of air they will perish as surely as if they were animals. There are two ways in which they may be affected. Like animals and human beings, plants continuously breathe in oxygen from the air and breathe out carbonic acid, but unlike the case of animals this breathing process goes on in all parts of the plant, including the roots. It is of course true that plant leaves during the day take in carbonic acid and give out oxygen, but this action is confined to the green parts of the plant and goes on only when the light is good enough. On the other hand, every part of the plant, roots included, breathes in oxygen, and unless there is sufficient fresh air in the soil the roots suffer. The second effect arises from the fact that plant roots are poisoned by too much carbonic acid. This action is more serious than was formerly supposed, and it is now known that considerable injury may result to the crop unless a way out is found for the carbonic acid in the soil.

One of the useful properties of both air and carbonic acid is that, like other gases, they can escape upwards, sideways, or downwards if a reasonably clear way is left for them. The Rothamsted soil is heavy and not easily pervious to air, nevertheless in the arable land the air in the soil is not usually more impure than in many rooms in houses or halls where meetings

are going on, though in extreme cases there is of course a considerable difference. Some of the analyses are:—

COMPOSITION OF THE AIR OF SOILS (PER CENT. BY VOLUME).

<i>Soil.</i>	<i>Usual Composition :</i>		<i>Extreme limits observed :</i>	
	<i>Oxygen.</i>	<i>Carbon di-oxide.</i>	<i>Oxygen.</i>	<i>Carbon di-oxide.</i>
Arable land, unmanured	20·4	0·2	18·0-22·3	0·01-1·4
Arable land, dunged ...	20·3	0·4	15·7-21·2	0·03-3·2
Grass land	18·4	1·6	16·7-20·5	0·03-3·3
Atmospheric Air ...	20·9	0·03		

At first sight it seems strange that air can get in and out of so solid looking a substance as soil, but as a matter of fact soil is nothing like as solid as it appears, but is full of pores which occupy a good deal more space than might be thought. Some of the figures obtained at Rothamsted show that 100 volumes of field soils there contain the following percentages of solid matter:—

	<i>Solid Matter.</i>	<i>Space empty, except for air and water.</i>
Unmanured arable soil ...	66	34
Well dunged arable soil ...	62	38
Pasture soil... ..	53	47

An exhibit has been put up at Wembley showing what the apparently solid soil would look like if it were magnified several hundred times. In the normal moist state about three-quarters of the pore space of the arable soil, and four-fifths that of the pasture soil, would be filled with water and the remainder with air. In many soils, especially in the western parts of England and the whole of Wales, the great obstruction to a free air supply and the escape of the injurious carbonic acid is the excess of water in the soil. Drainage is the well-known remedy. In the present economic conditions the individual landowner is not likely to attempt it, and indeed the individual is always handicapped in draining operations unless he can work over a sufficiently large area to take in the whole drainage system, because it is impossible to obtain the full benefits unless the whole watercourse is kept clear and the lands above and below are drained. It is hoped that the new schemes of credits instituted by the Government will facilitate these large scale drainage operations.

Cultivation.—Once the land is drained the great method for maintaining a suitable air and water supply is cultivation. Little has been done to study this ancient art, but a good beginning has been made in the Soil Physics Department at Rothamsted, and measurements are now taken of the work that has to be done in carrying out the various processes. It

has been shown that the amount of labour necessary is very appreciably influenced by the soil treatment; thus addition of chalk, lime or farmyard manure markedly diminishes the pull required, and certain artificials also act in the same way. The chalk does not show any effect if the land is very wet or very dry. Some of the Rothamsted results are:—

<i>Material used.</i>	<i>Condition of soil.</i>	<i>Percentage reduction in power required to plough, as compared with unmanured land.</i>
Chalk	Stubbles, dry	Nil
	Oct., distinctly moist ...	14·7
	Jan., very wet	4·6
Farmyard manure	Hoos barley field	22·6
Coarse ashes	" " " "	12·3
Super and sulphate of potash mixed	Broadbalk wheat field...	14·2
Super and sulphate of potash mixed, + 200 lb. sulphate of ammonia	" " " "	12·7
Super and sulphate of potash mixed, + 400 lb. sulphate of ammonia	" " " "	16·3
Super and sulphate of potash mixed, + 600 lb. sulphate of ammonia	" " " "	21·5
Super and sulphate of potash mixed, + 275 lb. nitrate of soda	" " " "	8·1

Fig. 2 shows one of the charts made by the dynamometer, from an accumulation of which these figures are worked out. The experiment deserves repetition on other types of soil, the saving in power being quite considerable.

Another highly interesting investigation begun in the Physics laboratory has shown that the resistance to the plough may be considerably reduced by means of an electric current which could be generated by the tractor. The investigation is as yet only in the laboratory stages, but the principle is sound, and the technical difficulties may yet be overcome.

Depth of Soils.—Another factor greatly influencing the air and water supply is the depth through which the plant roots can range. It is a common defect of many soils that they are too shallow; what there is of them may be very suitable for the plant, but there is not enough. The trouble has been intensified on the heavier soils in the eastern counties by the custom common 30 or 40 years ago, and still surviving in places, of ploughing to a uniform shallow depth, sometimes with a heavy plough. The result is the formation of a plough

sole through which plant roots have great difficulty in penetrating. Very beneficial results have been obtained in Essex from subsoiling, which allowed the roots a bigger range and enabled them to get at more of the water supply. There is no evidence that any appreciable amount of food is derived from the lower soil thus opened up, but the larger and more uniform water supply enables the plant to make full use of the food materials present in the top soil or added in fertilisers without the wastage that at present often goes on.

Even where the ploughing has not been persistently shallow subsoiling has often proved an advantage. At Rothamsted it gave an additional half ton of potatoes without the use of any more manure.

Unfortunately there are many cases where the thin soil is underlain by rock or gravel, and here nothing can be done to deepen the soil beyond the artifices already known to the farmer.

The Re-action of the Soil: Sourness.—One of the most important factors in determining the value of the soil for crop production is its state of sourness or otherwise; in chemical language its reaction. The practical remedy is of course well known: it is to apply lime in one or other of the forms available—either lump lime, ground lime, or limestone, whichever on analysis appears to be the better value at the farm. Farmers can tell without difficulty when grass land has become sour; the change in character of the herbage, the weakening of the clovers, the dark green unhealthy colour of some of the grass, and above all the patchiness of the pasture, are all reliable indications. In our experience, however, farmers have more difficulty in recognising when the arable land is sour, and we have had several cases referred to us of crop failure without apparent cause, which on examination turned out to be simply sourness. Crops vary in the ease with which they show the “souring” effects; oats and potatoes do not show up as sharply as swedes or mangolds. Again the patchiness is a usual indication. Another indication is the failure of the root system to develop; mangolds, for example, in sour land refuse to grow up, remaining small undeveloped plants with roots that will neither spread into the soil nor swell out, while their foliage is yellowish and unhealthy looking.

Before sourness has got as far as this it may well have caused much loss to the farmer through failure to obtain the full benefit to which his expenditure on cultivations and manures entitles him. It is therefore very important that the agricul-

tural advisors should be in possession of methods whereby they can ascertain whether the soil is becoming acid before any important loss has occurred. The farmer can, if he likes, disregard the warning, but at any rate he will know where he stands. For some years past the Research Institutes have been busy devising various methods, and one is now in use at Rothamsted which enables the analyst to "place" the soil on the scale and to say whether it still has a margin of safety or whether it is becoming rather dangerously near the limit.

In connection with this investigation certain field experiments on liming have been organised by the Ministry of Agriculture and are being carried out by County Organisers, and it is hoped as a result of the work to be able to advise farmers within a few cwt. per acre how much lime they should add to bring the soil within the safety zone. The scale as used at Rothamsted and elsewhere is based on a system of measurement of what the chemist terms the PH values, in which 7 represents the perfect neutral condition, 4 represents a bad acid condition in which no crop will grow, and intermediate values represent conditions which certain crops will, and others may not tolerate. Values higher than 7 are not common in this country, but they occur among the alkali soils found in parts of the Empire.

It is not sufficient to put the reaction of the soil right by adding the proper amount of lime: unfortunately for the farmer it will not remain right. Of all soil constituents none is so seriously liable to loss as lime. We hear a great deal about loss of nitrates from the soil in a wet winter, and owing to their cost it is quite proper that we should, but the loss of lime is on a far greater scale. Fig. 3 shows in diagram form what happens in a single year to the fertilising constituents of the soil in which a crop of wheat is growing. A certain amount of each of them is withdrawn from the soil. In the case of potash and of phosphate practically the whole of the material so withdrawn finds its way into the crop and is thus usefully employed. In the case of nitrogen the amount drawn from the soil is much greater, and here only part—in this case about one-half—gets into the crop, the remainder goes into the drainage water. This loss is serious and expensive to the arable farmer, and is particularly marked in a wet winter; in a dry season where the plant is making better root it is diminished. Methods of reducing these losses are being tried at Rothamsted, this work forming an important part of the investigations on soil improvement.

THE FEEDING OF ANIMALS.

PROFESSOR T. B. WOOD, C.B.E., M.A., F.R.S.,

Drapers Professor of Agriculture, and Director of the Animal Nutrition Research Institute, University of Cambridge.

THE feeding of animals is undertaken for the most part with the object of converting the coarser produce of the soil into animal products for human consumption. This is at once both wasteful and necessary: wasteful because on the average the food-producing live stock of Great Britain consume about 40 lb. of the produce of the soil, weighed in the dry state, for every lb. (also weighed dry) of edible animal product they produce; necessary because it is only through the agency of animals that the coarser and more bulky produce of the soil, such as hay, straw, grass and roots, can be converted into human food.

Granted the necessity for this wasteful form of food production, it is clearly most desirable that every effort should be made to reduce the wastefulness to its lowest possible limit. Hence the need for research in animal nutrition.

Broadly speaking, two kinds of research are required. In the first place we need scientific research into the fundamental aspects of nutrition, which to the man in the street may appear to be as far removed from agricultural application as were Faraday's experiments with a magnetised needle in the cellar of the Royal Institution from their present-day application—the electric motors which propel the underground trains and the dynamos which provide them with the power they need. Secondly, we require practical research, which is, or should be, concerned with working out the practical application of the ideas originated by the fundamental investigators.

Both these types of work are in progress in Great Britain at the present time, the former being chiefly concentrated at Cambridge; at the National Dairy Research Institute at Reading; and at the Rowett Research Institute at Aberdeen. The more practical research into the application of fundamental principles to the practice of economic feeding is at present undertaken, not only by the three Research Institutes mentioned above, but by most of the agricultural colleges and by some of the farm institutes and county organisers connected with the county councils. In this branch of the work there is room for the organisation of team work. At present each investigator works on independent

lines, which is excellent for really original research but is apt to fail in yielding reliable practical results of immediate general application. Notable exceptions are the excellent practical results which have been obtained in several areas by the rationing-for-milk schemes worked in connection with milk recording.

The Cambridge Animal Nutrition Institute has worked chiefly at the general relation between the quantity of fodder consumed and the quantity of meat produced, and its more important results have recently been published in a small volume entitled *Animal Nutrition*, written by the Director and published by the University Tutorial Press. This volume sets out a system of rationing all kinds of animals in accordance with the result which the feeder desires to produce. A second section of the Institute, under the direction of Dr. F. H. A. Marshall, F.R.S., Reader in the University in Agricultural Physiology, has investigated the physiology of reproduction in farm animals. Perhaps its most important achievement is the demonstration that sterility in mares and cows is frequently caused by the persistence of the "yellow body" in the ovary. This has been given practical application in a simple operation by which the "yellow body" is squeezed out, when the animal again becomes capable of breeding. Other problems which have engaged the attention of the Cambridge staff are the separation and characterisation of the proteins of various fodder crops, the strength of wheat flour, the digestibility of various home-grown fodders, and the growth and development of various breeds of live stock. A poultry section has recently been added to the Institute.

The Rowett Research Institute at Aberdeen, under the direction of Dr. J. B. Orr, D.S.O., has only been completed since the war. It has, however, already developed a characteristic line of investigation, namely, the importance of the ash constituents of the diet on the growth and development, and especially on the health, of animals. This important subject has never received the attention it deserves, and in Great Britain has been scarcely touched. Already Dr. Orr and his staff have clearly demonstrated that an inadequate supply of ash constituents produces an immediate and direct effect on the well-being of animals comparable with the effect of deficiency of vitamins, for which it is frequently mistaken.

INSOLVENCIES AMONG FARMERS.

A. W. ASHBY.

UNDER all possible circumstances and in the very best of times a certain number of farmers not only fail to make their enterprises profitable, but lose a part or the whole of their original capital.

The causes of insolvency amongst farmers are many and varied. They may be either wholly personal, or wholly economic, or personal causes and economic causes may combine to make individuals insolvent. Or special causes may be some form of disaster arising from natural phenomena such as drought or flood. On the whole, the personal causes are predominant. This cannot be doubted when it is remembered that the average number of bankruptcy receiving orders and deeds of arrangement for 10 pre-war years amounted to 317. The highest recorded numbers since records were first made available in 1891 were :—

1893	...	...	...	...	523
1894	...	...	...	...	518
1895	...	...	...	...	564
1896	...	...	...	...	466
1897	...	...	...	...	407
Average 5 highest years					496

As the average for all the years from 1891 to 1923 is 352, and this includes the worst years which have occurred, and the best which can be imagined, as for instance 1918 when the number of cases fell to 33; and as the average for the five fairly normal years of 1909 to 1913 was 304 cases, about 300 cases per year must be the normal expectation. In this case, the figures which represent the pressure of general economic forces upon the industry in general, and upon individuals in particular, are those in any year which are in excess of 300. In 1895, the worst year of any recorded, for instance, about 264 of the 564 cases represent the pressure of general economic forces. Again, in 1923, of the 482 recorded cases about 182 represent the effect of pressure of general economic forces.

The personal causes of failure are of a varied character. The cause may be lack of knowledge or experience of the industry, general inefficiency or inattention to business, or living in excess of income while the business is paying moderately well.

Special economic forces may be (a) speculative production, (b) lack of capital, or even over-capitalisation. and (c) in some

cases "over-reaching" of business capacity or capital (or, as the general trader would say, "over-trading").

General economic causes are mainly connected with changes in price-levels, either (1) of nearly all commodities, as in 1921, or (2) of special groups of commodities, as in the case of cereals in the 'nineties, or (3) in the price of one article of specialist production, such as hops. These press heavily on all farmers or on special groups of farmers according as they cover all commodities or special groups. These price changes and their effects are illustrated by the figures for insolvencies between 1893 and 1897, and again since 1921. The causes arising from natural phenomena may also be varied in character, or operate on a national or local scale. A local flood or a local drought or hailstorms may affect the farmers in special localities, or the whole country may suffer from abnormally high rainfall or from drought. Particular farmers or a local group may suffer from diseases amongst animals or pests amongst crops. But when all is said that can be said of causes of insolvency, it remains true that the normal expectation must be about 300 cases, and it is probably true that in two-thirds of these cases the cause is connected with the person in charge of the business or with the conditions of the individual business itself. The remaining one-third may be due to causes not under the control of the individual manager which arise from natural phenomena or from economic conditions.

This being the case it is necessary to measure the proportion of failures which occur amongst farmers, and so far as insolvency becomes public the following figures represent the proportion of insolvent businesses to the total:—

Average of 5 years—1909-13	...	...	...	17 in 10,000
Year 1912	...	...	...	19 " "
" 1913	...	...	...	18 " "
" 1921	...	...	...	16 " "
" 1922	...	...	...	22 " "
" 1923	...	...	...	27 " "

It is more difficult to estimate the proportion of total farming capital lost in insolvent businesses, but it appears that in pre-war years about £17 in £10,000 of the total of farming capital, or in 1922 about £22 in £10,000, was so lost.

When insolvencies are caused by general economic forces there may be some lapse of time between the operation of the forces and the actual declaration of insolvency. But this lapse

is not so great as might be expected, for it amounts to only about one year, and when, for instance, price changes are violent it may be less. Taking the post-war years, it is found that the number of cases increased very much from 1920 to 1921 and has continued to increase until the last year. But if prices now remain stable it may be expected that the number of cases of insolvency will diminish. Taking the figures for the last three years, as follows:—

1921	...	...	...	...	285
1922	...	...	...	...	403
1923	...	...	...	...	482
Average					390

it may be seen that the actual occurrences are not much in excess of normal expectation, and that in the case of the last big decline in prices there was not a great lapse of time between the price change and the increase in insolvency.

During the recent depression of prices it might have been expected that there would have been more insolvencies in the arable area than in other areas of England and Wales. In so far as information is available, this does not appear to have been the case, for *as regards the number of cases of public insolvency* occurring amongst farmers the pasture areas have suffered more than the arable areas. When, however, the liabilities in cases of insolvency are considered, the results of *bankruptcy* are fairly well distributed over the whole country.

The liabilities in cases of public insolvency, as well as the number of cases, have been heavy during the last two years. If, however, allowance is made for the change in the value or purchasing power of money, these are not much greater than in pre-war years. For the five years before the war the average yearly amount of total liabilities was £325,500, and the average of liabilities per case £1,070. During 1921 the total of liabilities amounted to £826,800 or £2,900 per case. When the 1921 figures are reduced by the index number of general commodity prices, which stood at 219 as compared with the pre-war index, these sums are reduced to £444,500 and £1,560 respectively. Similarly, the liabilities for 1922, which in sterling amounted to £768,000 or £1,906 per case, fall to £489,000 and £1,214 respectively when reduced to pre-war values.

* * * * *

IMPROVEMENT OF GRASSLAND IN YORKSHIRE.

J. A. HANLEY, A.R.C.S., Ph.D.,

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EXPERIMENTS on the improvement of grassland have been in progress on the experimental farm of the University of Leeds at Garforth, and at other centres in Yorkshire, for upwards of 30 years, but in 1919 the number of centres at which grassland experiments were laid down was largely increased, until at the present time there are about 50 series of plots, in addition to those at Garforth, on private farms throughout Yorkshire. Yorkshire farmers have co-operated so willingly, and have put such numerous types of soils and grassland at the disposal of the University that a great deal of useful information on the treatment of poor grassland is now being accumulated.

A brief account of the results obtained up to the end of the season of 1923 may be useful.

Use of Lime.—The older experiments, together with the experience of many grassland farmers, appeared to indicate that large areas of poor grassland did not respond readily, and some not at all, to phosphatic manures. Even the old form of high grade basic slag, the use of which revolutionised grassland manuring on large areas of land throughout the country, appeared to have little or no effect on permanent grassland of certain types in Yorkshire. It was noticed, moreover, that where this lack of response to phosphates was experienced, liming was often very effective.

The first series of experiments laid down was designed to deal with this problem, and grassland was chosen which showed those signs usually regarded by the practical man as pronounced indications of want of lime.

At first eight distinct types of soil were chosen, and the fields selected for each type were the worst which could be found at the time, when judged by such signs of want of lime as a general absence of clover, the prevalence of bent and other unpalatable and badly grazed plants, and the accumulation of partially decayed vegetable material usually referred to as a "skin" or "mat" on the surface of the soil. The eight centres originally selected in 1919 have since been increased as opportunity offered, usually through the channel of advisory work.

Table I contains a list of centres, including the eight referred to above, on which lime and slag have been used and which are

TABLE I.
EXPERIMENTS WITH LIME AND BASIC SLAG.

Soil.	Centre.	Expt. begun.	* Lime Require- ment.	Effect of Lime.	Effect of Slag.	Effect of Lime followed by Slag.	Effect of Potash.
Coal Measures Soils	Butley	Spring 1920	60	After three years noticeable im- provement	No apparent improvement	Similar lime alone	Slight additional improvement where used with lime
	Sharlston Nostell	do. 1921	49 25	do. After two years noticeable im- provement	do. Some improve- ment	do. —	do. —
	Parlington	1920	23	Slight improve- ment (Limestone used)	Marked im- provement	—	—
Millstone Grit Soils	Silsden	Spring 1920	30	After three years very marked im- provement	Noticeable in- crease in amount of clover	Best plot	Improvement where used with Slag or Lime
	Saddleshworth	1919	56	Noticeable improve- ment from quick- lime and carbon- ate of lime	No apparent improvement	—	—
Light Sandy River Alluvial Soils	Beamsley	Spring 1920	22	After three years marked improve- ment	Noticeable in- crease in amount of clover	Noticeable im- prove- ment	—
	Bolton Abbey	1921	15	After two years slight improve- ment	Marked im- provement	—	No noticeable improvement

Boulder Clay Soils, Medium to Heavy	New Houses Niddale	1921	21	After two years slight improve- ment	Marked im- provement	—	—
Light Sandy Glacial Soil	Thorn-ton-le Beans (N.R.)	Spring 1920	23	Noticeable improve- ment	Noticeable im- provement	Best plot	No noticeable improvement
	Thornborough (N.R.)	do.	16	No improvement	Very marked improvement	—	—
	Brompton (N.R.)	1921	30	Very little improve- ment	Very marked improvement	—	No noticeable improvement
	Ainderby Steeple	Spring 1920	26	Noticeable improve- ment	Very marked improvement	Very marked improve- ment	Improvement where used with slag or lime
Peat Soil (Carr Land)	Swine	Spring 1920	68	After two years slight improve- ment	No improve- ment	—	No noticeable improvement
	Dunsell	Spring 1920	30	After two years slight improve- ment	Noticeable im- provement	Very marked improve- ment. Best plot	No noticeable improvement
Heavy Alluvial Soils	Howden	1921	9	Very slight improve- ment	Noticeable im- provement	—	—
	Hyckham	1919	28	Noticeable improve- ment	Slight improve- ment	Best plots	—

* The "lime-requirement" figures have all been determined by the Hutchinson-MacLennan method. The figures given represent cwt. of quick lime per acre absorbed by the soil under the conditions adopted in the laboratory. If divided by 100 the figure obtained gives the percentage of calcium carbonate absorbed, e.g., a "lime-requirement" of 25 means an absorption of 0.25 per cent. calcium carbonate, a "lime-requirement" of 9 means an absorption of 0.09 per cent. calcium carbonate.

already showing definite signs of improvement due to applications of either lime or slag.

The results of these experiments indicate that such poor, badly-grazed grassland can be divided roughly into three classes:— (1) land which will not respond to phosphates (including high grade basic slag) but which responds to lime; (2) land which is not noticeably improved by liming but which responds in a wonderful way to suitable phosphatic manures; and (3) an intermediate class which is improved either by liming or by the application of phosphates.

Soils that need Lime.—The outstanding characteristics of grassland in Class (1) are:—

(a) The presence of a “skin” or “mat” well seen in section if a turf is dug out with a spade. This “mat” is so tough that it is impossible in the worst cases to work through it to the soil below with the finger. It must not be confused with the layer of dead material which may accumulate by two or three years’ insufficient grazing, and which can easily be worked through with the finger; in such cases where the soil can easily be touched the grassland belongs more probably to Class (3) or even Class (2).

(b) The almost complete absence of clover and perennial ryegrass.

(c) The presence of a large proportion of bent (*Agrostis vulgaris*) and creeping bent (*Agrostis stolonifera*) often called water grass.

(d) The comparatively small number of species of plants represented.

The soil of such land when examined in the laboratory has a high “lime-requirement,” usually over 40 (see Table I), or sometimes as low as 30 in the case of light sandy soils.

As a rule any bare spaces in the turf are covered by the usual “mat,” and the soil is not exposed. In smoky districts, however, the “mat” becomes blackened and breaks easily, owing apparently to the action of the smoke, and if the covering of such material over the soil is thin, some weeds, especially sheep’s sorrel and sometimes yarrow, take possession of these bare spaces.

In some parts of Yorkshire the herbage includes more typical moorland plants such as moor mat grass or white bent (*Nardus stricta*), heath bedstraw (*Galium saxatile*), heather and bilberry, and there are many instances of remarkable improvements, still showing plainly, which were effected by applications of lime up to 50 years ago. Some of these patches have been included

in experiments recently laid down, *e.g.*, slag has been applied with very good results to such areas which had been previously limed, but where such a slag plot has been extended so as to include areas not previously limed there has been no noticeable improvement from the application of the slag.

The soils on which this grassland, which responds so well to applications of lime, occurs, are derived chiefly from Coal Measures, Millstone Grit, Yoredale Grit and Moor Grit, the first three in the West Riding, and the Moor Grit in the Scarborough-Whitby-Pickering area. The worst cases occur as a rule where there is no Boulder Clay, although in places where the Glacial Drift consists largely of Grit material, *e.g.*, in a thin covering of drift overlying Grit rock, the need for lime is often very pronounced. As a general rule the Boulder Clay of the West Riding gives rise to soils with an apparently higher lime-requirement than the Boulder Clay occurring further east; partly because of the higher rainfall in the west, and partly because there is a higher percentage of chalky material in the East Riding Boulder Clays. In the West Riding where the Boulder Clays overlay limestone or Yoredale Shales the grassland will often respond readily to phosphates without a previous application of lime.

Effect of Lime.—On matted types of grassland the first improvement noticeable after liming is a pronounced stimulus to the grasses. If the lime has been applied during winter or early spring, the limed plots usually stand out because of the fresher, greener herbage they carry during the spring, even if the lime has only been applied a few weeks previously. In some cases a magnesian lime has given more marked results than a pure lime. Two or three years after the application of the lime the most marked alteration in the herbage is a large increase in the proportion of fescue and a corresponding decrease in the proportion of bent (*Agrostis*).

TABLE II.
EFFECT OF LIME ALONE ON FESCUES AND BENT.

Centre.	Year when lime applied.	Year herbage analysed.	Percentage area covered.			
			Fescues.		Bent.	
			Not limed.	Limed.	Not limed.	Limed.
*Garforth ..	1911	1917	17	29	26	7
Batley ..	1919-20	1923	34	46	17	1
Sharlston ...	"	"	27	31	25	6
Silsden ...	"	"	21	43	22	4

* Percentage of fescues and bent in hay (not percentage area covered).

The most important point about liming, however, is the way in which it prepares the land for subsequent treatment with phosphates which complete the improvement. Some of the better grasses, and particularly perennial ryegrass, do not appear to be nearly so tolerant of "acid" soil conditions as wild white clover.

An important factor checking the development of clover is the presence of a "mat" and the coarse and badly-grazed grasses, particularly bent; under such conditions the clover is suppressed—it is over-shadowed by grasses during the whole of the growing season, and on account of the mat cannot get its runners into contact with the soil. Liming gradually reduces the mat and exposes the soil. Some of this work appears to be accomplished indirectly by earth-worms. The work of earth-worms appears to be stimulated by liming, and on more than one occasion the lined plot has been located on grassland through the presence of a larger number of worm-casts.

On some of the Millstone Grit pastures, where the conditions are often semi-moorland, liming will encourage the spreading of wild white clover to an extent comparable with that obtained by applications of basic slag to such soils as the boulder clays. A further important point about the use of lime on some grassland is that the increased growth of wild white clover is thereby made more permanent. The deficiency of lime is usually a much more serious drawback to the improvement of bad grassland on these West Riding soils than the deficiency of phosphate, although as soon as the lime has begun to alter the sour conditions a further improvement may be effected by applications of phosphate. This has been most marked on the Silsden plots.

(To be concluded.)

* * * * *

ESTABLISHING A TUBERCULOSIS-FREE DAIRY HERD.

S. E. B.

WITH the ultimate object of obtaining a herd free from tuberculosis, 250 cows and heifers under the management of the writer were subjected to the tuberculin test in the autumn of 1922. The animals tested consisted of 121 milking cows located on three different farms, and 128 heifers of varying ages from 6 months upwards.

All the animals with the exception of 11 cows were home-bred. It was hoped that a nucleus of tuberculosis-free animals

would be obtained to start the immediate production of Grade-A Tuberculin Tested Milk, for which a demand was known to exist.

As, however, the principal object of the test was the establishment of a tuberculosis-free herd, extraordinary care was taken to eliminate, not only the animals definitely reacting to the test, but to exclude animals about which there was even the slightest suspicion. There is little doubt that, though this policy has now proved to be the correct one, the rigorous treatment classed many animals as reactors which probably were not so in reality.

The services of a veterinary surgeon who had had wide experience in this class of work were obtained, and he appointed a fully qualified assistant who resided on the estate during the time the testing was in progress.

The ultimate success obtained in the subsequent "tests"—as will be shown later—was due to the extreme care with which the actual inoculations were performed, and more especially to the manner in which the results were recorded and interpreted.

Method of Testing.—Tuberculin test sheets were printed, and a separate sheet was used for each animal. The form of this sheet is shown on p. 140.

The subcutaneous, ophthalmic, and intradermal tests were applied simultaneously.

As far as possible all animals were subjected several days before inoculation to the same conditions under which they would be tested, *i.e.*, they were tied up day and night, fed, watered and milked at fixed times, and made to become accustomed to the presence of strangers, and lights in the sheds at night. This was not a serious business as far as the cows were concerned, but for the young stock which were being "handled" for the first time, it was found necessary to allow at least two full days between tying up and inoculation.

Temperatures were taken at 7 a.m. and 5 p.m. on the day previous to inoculation, and the following day at 7 a.m., 5 p.m. and 10 p.m., at which last hour inoculation took place. In the original "test" post-inoculation temperatures were taken at the 9th, 12th, 15th and 18th hours, an examination of the eyes only being made at the 6th hour. In the subsequent tests the hours of pre- and post-inoculation temperatures were altered to comply with the Ministry of Health's

regulations. After the 18th hour in doubtful cases temperatures were taken, and "eye" and "tail" examinations made at the 21st and 24th hours, and later, if necessary.

TUBERCULIN TEST SHEET.

<i>Temperature (Before inoculation).</i>		Animal		
		Breed	Sex	Age
		Tuberculin		Dose
		Date	Time	Place
		Average Group Temperature		Result
<i>At Inoculation.</i>		<i>Eye Reaction.</i>	<i>Tail Reaction.</i>	<i>Remarks.</i>
<i>(Hours after ino- culation)</i>				
6th				
9th				
12th				
15th				
18th				
21st				
24th				
36th				
60th				
84th				
108th				

Any animal which showed even a single abnormal pre-inoculation temperature was put back to be tested in a subsequent group.

As the taking of temperatures and the inoculation of nearly 250 animals within the space of three weeks was not only rather a large but a tedious operation, it may be of interest to describe the method of procedure which was finally adopted, and which proved the quickest and most saving in labour.

Animals which had never been tied up before were driven 3 to 6 at a time into a large calving box. One man, B, was stationed at the door of the box, whilst another man, A, went inside and threw a looped rope over the head of the first animal he could thus lasso. A then drove this animal to the door, which B opened, and which A closed as he came out. Meanwhile, two other men, C and D, had passed the free end of the rope through the ring or staple from which hung a cow chain where it was intended the animal should stand. As soon as the animal bolted from the box, C and D, and subsequently B, hauled in the slack while A guided the animal, and prevented it as much as possible from injuring itself. As soon as the heifer had been drawn and coaxed up to the manger, A and B chained her up. In this manner all of the 128 heifers were in turn secured without accident.

Taking Temperatures.—The most convenient number of animals to deal with at a time was found to be between 30 and 40. For the temperature taking, which was done throughout by the resident veterinary surgeon, two stockmen and a clerk were employed. The writer, with the aid of the stockmen to steady the animals, inserted four thermometers, one into the rectum of each of four animals, the clerk noting the time when the first thermometer was in place. As soon as the first thermometer had been in one minute it was taken out by the veterinary surgeon, the reading announced to the clerk, shaken down, and inserted in the next, *i.e.*, the fifth in order of standing. The employment of the two stockmen was found to be absolutely necessary; their duties consisted of occasionally "nosing" refractory animals, but more especially guarding against the loss or breakage of thermometers by their being forced out during defecation.

Inoculation.—At the time of inoculation, excluding the veterinary surgeon and the writer, five men were employed. Whilst the former was preparing his syringes and materials, his assistant, with two men and the clerk, took and recorded the temperatures. Before this was completed the veterinary surgeon, with the aid of two men, started the inoculations, one man holding the lamp, and the other holding the animal by the nose with a pair of "bulldogs." As soon as the temperature taking was finished the two men who had assisted at it were sent home, and the assistant helped the veterinary surgeon by filling and handing him the syringes as required. In the above manner it was found possible, without fuss or unduly exciting the animals, to inoculate 30 in just over the hour.

The above description of the securing and the inoculation of the animals may appear superfluous, but, in the writer's opinion, this method adopted from the start resulted in each animal being treated quickly, quietly and efficiently, and it not only saved much time in the long run, but tended to eliminate the possibility of abnormal rises in temperature.

Results of First Test.—The first test showed that the herd in general was heavily infected, and, as might be expected, a heavier percentage of "reactors" among the milking cows than among the young stock. The results obtained from the latter are given in Table 1.

Table 1.—*Tests of Young Stock*

<i>No. Tested</i>	...	128							
<i>No. Passed</i>	...	71			<i>Percentage passed</i>	...	55.4		
<i>No. Failed</i>	...	57							
<i>Under 1 year old (20)</i>	...	45		<i>per cent. passed</i>	...	<i>Average age in months</i>	9		
<i>1 and under 2 years (46)</i>	...	65.2		"	"	"	"	"	15
<i>2 and under 3 years (47)</i>	...	51		"	"	"	"	"	29
<i>3 years old and over (15)</i>	...	53.3		"	"	"	"	"	39

As soon as each batch of animals had been tested, those which passed were immediately separated from the rest, and were sent to sheds or yards which had been thoroughly cleaned and disinfected beforehand, and which had held no live stock since the previous spring.

Effect of the Test.—The effect of the test upon the reacting animals was most marked, and from close observation at the time, and from their subsequent history, it would appear that they suffered in direct proportion to the degree to which they were affected with tuberculosis. The cows in milk, and the recently calved heifers, received the biggest setback. The reaction to the tuberculin, from a clinical point of view, appeared to be at its height at about the sixth hour (4 a.m.). The reacting animals had a distinctly hang-dog appearance, their coats were "stary," their skin felt hidebound and hard and dry to the touch, their muzzles were hot, and in general the animals looked ill at ease.

The immediate effect on the young stock was much less marked, but for several weeks subsequent to the test the animals, which were previously in good condition, ceased to "do," and in many cases actually lost in condition. The above observations were amply confirmed by the independent witness of the cowmen and stockmen in charge of the animals. The ill effects of the test on the reactors had completely disappeared three months after it had taken place.

It does appear that the tuberculin test in some way stirs up, and in some cases actually advances a stage, the progress of the disease in the animal.

In no single case did the test appear to affect the health of the non-reacting animals. Herd owners must, however, be prepared, even in herds free from tuberculosis, to expect a slight temporary falling off in the milk yield during and immediately subsequent to the testing of the cows, but this is attributable to the disturbance necessitated by the actual inoculation and temperature taking; and it is chiefly noticeable among the more excitable animals, and the heavy milkers.

Results of Subsequent Tests.—Naturally, some anxiety was felt when all the animals in milk (or due to calve within six months), which had passed the test in the autumn of 1922, were due for re-testing in the spring of 1923. Of the 36 animals re-tested only two had to be rejected. A subsequent re-test in the autumn of 1923 showed again only two reactors, and this time out of 54 animals originally passed in 1922.

In view of the comparatively heavy infection at the beginning, the results of the subsequent re-tests may be considered satisfactory.

It would appear that the presence of even so small a percentage of reactors among animals which had passed the original test must be accounted for in one or another of the following ways:—

- (i) Even the most searching test is not infallible.
- (ii) The animals were infected from the buildings, or as is most likely, infection had already taken place at the time of the first test, but was of too recent occurrence to induce a reaction to inoculation with tuberculin.

Milk Yield and Health of Reactors and Non-Reactors.—As has already been stated, the immediate effect of the test upon reacting and non-reacting animals was sufficiently marked to cause notice, and a comparison of the subsequent health of the two classes of animals is instructive. Observation suggested that the non-reacting animals carried more flesh for the same quantity of food than did the reactors, and this in turn suggested that the non-reactors might yield richer milk than that given by reactors. In order to determine whether this was so, a comparison of milk yields and butterfats was made between the first 11 animals in the non-reacting herd, and 11 reacting animals of a corresponding age, and period of lactation, with the result shown in Table 2.

Table 2.—Comparison of Butterfat and Milk Yield, June 17th, 1923, to January 7th, 1924.

Non-Reacting Cows.

No. of Cows.	Born.	No. of Calves	Last Calf.	Butterfat. per cent.	Tests.	Milk Yield.	Days.	Average Daily Yield.
						lb.		lb.
1	5. 1.1919	2	9.12.1922	4.066	6	6.012	168	37.7
2	15. 8.1919	1	1. 8.1922	3.9	6	4.004 $\frac{1}{4}$	204	19.6
3	12.12.1919	1	24. 7.1922	4.525	4	2.521 $\frac{3}{4}$	84	30.0
4	17. 3.1919	2	8. 3.1923	4.137	8	3.186 $\frac{1}{2}$	204	15.6
5	7. 9.1919	1	28.12.1923	3.875	8	6.902 $\frac{3}{4}$	204	33.8
6	15. 5.1920	1	12. 1.1923	4.5	6	2.708	169	16.0
7	21.11.1919	1	15. 1.1923	3.825	4	2.393 $\frac{3}{4}$	148	16.2
8	6. 5.1920	1	2. 2.1923	3.633	6	3.799	169	22.4
9	16. 9.1919	1	6. 2.1923	3.616	6	4.825 $\frac{3}{4}$	204	23.6
10	28.10.1919	1	5. 3.1923	3.566	6	5.631	204	27.6
11	17. 4.1920	1	3. 5.1923	3.45	8	6.276	204	30.7

Average 3.917 — — — 24.6

Reacting Cows.

No. of Cows.	Born.	No. of Calves	Last Calf.	Butterfat. per cent.	Tests.	Milk Yield.	Days.	Average Daily Yield.
						lb.		lb.
1	23. 6.1919	2	25.11.1922	3.23	10	4.786 $\frac{3}{4}$	204	23.4
2	1. 8.1919	1	5. 8.1922	3.68	10	4.325	204	21.2
3	11.11.1919	1	29. 7.1922	3.925	8	4.467 $\frac{1}{2}$	175	25.5
4	19. 2.1919	2	23. 2.1923	4.32	8	3.772 $\frac{1}{2}$	204	18.4
5	2. 9.1919	1	7. 1.1923	3.37	10	6.204	204	30.4
6	19. 4.1920	1	24. 1.1923	3.812	8	3.971 $\frac{3}{4}$	176	22.5
7	14. 8.1919	1	4. 2.1923	3.25	10	6.670 $\frac{1}{2}$	204	32.7
8	21. 2.1920	1	2. 2.1923	3.266	6	4.753	164	28.9
9	9. 8.1919	1	25. 1.1923	3.908	12	4.047	204	19.8
10	6. 8.1919	1	13.12.1922	3.442	8	5.219 $\frac{1}{4}$	167	31.2
11	21. 2.1920	1	19. 1.1923	4.24	10	5.162	204	25.3

Average 3.676 — — — 25.298

The fact that the reacting cows over the period under review show a slightly higher daily average milk yield than the non-reactors is no criterion. As a matter of fact, taking all the animals throughout the year the non-reacting animals by no means lower the average of the rest. On the other hand it is not intended to suggest that a non-reacting cow will yield more milk than a reactor, except that in the long run she will probably last longer.

One striking comparison between the reactors and the non-reactors has impressed itself strongly upon the writer's mind, and has greatly increased his confidence in the efficacy of the test, and that is the remarkable freedom of non-reacting

animals from minor ailments. During the past eighteen months no cases of chills, indigestion, stoppage, garget, milk fever, or repeated returning to the bull, have occurred in the "free" herd. Retention of the foetal membrane, with all its attendant troubles, a more or less frequent occurrence among the reactors, appears to be a thing of the past. Finally, the after-effects of calving among the non-reacting animals are almost negligible. No matter how high the condition before calving the majority of reacting cows, as soon as the calf is removed and the serious business of heavy milk production begins, appear incapable for many weeks of preventing the wasting of their own bodies at the expense of the milk pail. The non-reacting cows, however, appear not only to suffer less from the actual strain of calving, but are able to maintain their "bloom" without restricting their flow of milk.

Disposal of Reacting Stock.—The results obtained from the original test in 1922 created two very serious problems, namely:—

- (i) The disposal of the reacting animals.
- (ii) The rearing of tuberculosis-free calves from reacting animals whose stock it was desired to retain in the herd.

The first problem was solved by a very thorough clinical examination by the veterinary surgeon. All animals with suspicious udders or showing clinical signs of tuberculosis were immediately drafted out, and sent to the knacker.

Rearing Calves from Reacting Cows.—The second problem proved extremely difficult to solve owing to the surprising lack of authoritative information on the subject. The first step taken was to remove from the calf pens all the heifer calves which were under six months old, and which, consequently, had not been subjected to the test. The pens were then thoroughly scrubbed, disinfected and lime-washed. At the same time additional pails were purchased, and were used for calf rearing only.

It was next decided to take away all heifer calves at birth from their (reacting) dams, and to feed them on either whole milk from the non-reacting animals, or boiled milk and cod liver oil, the former from the reacting cows.

This experiment, besides being in great disfavour among the cowmen, proved highly unsatisfactory. Although several calves were reared in this manner, the majority of them, especially the smaller and weaker ones, developed on the

second or third day what was thought to be contagious "white scour." Two calves died in spite of unremitting care and attention, and post mortem examinations of these showed them to be victims of septicaemia. Two other calves, as soon as they showed signs of scouring, were put back on to their dams, and the scouring stopped within twenty-four hours.

This experience showed the inadvisability of withholding the colostrum from the calves, and appeared to be a practical confirmation of the view that the first milk of the dam confers upon the newly-born a power of resistance against bacterial infection.

After the lack of success described above, calves were left with their dams for four days, as had been the usual practice

Table 3.—*Calf Rearing with Boiled Whole Milk and Cod Liver Oil.*

<i>Age of Calf.</i>	<i>Food.</i>	<i>No. of Feeds.</i>	<i>Remarks.</i>
Birth till 4 days old	Dam's milk only	Ad lib.	The calf is left continually with the cow for the first 4 days. A certain amount of milk is drawn from the cow twice a day at the discretion of the cowman.
4th day to end of 4th week	8 pints of boiled whole milk daily containing 1 tablespoonful cod liver oil	3	<i>Hay and Rock Salt.</i> These are always in reach, only the best and "softest" hay being used. Calves will start licking the salt, and nibbling hay about the end of the 2nd week <i>Ingredients and consistency of Gruel.</i> 7 oz. of a mixture consisting of 7 parts linseed cake meal, 3½ parts whole linseed, 1 part locust bean meal are mixed with 1 gallon of water <i>Meal.</i> Calves are encouraged to eat a meal consisting of 8 parts linseed cake, 8 parts crushed oats, 6 split beans, 1 part fish meal, and are allowed up to 3 lb. per head of this at 9 months old
5th-8th week	4 pints boiled whole milk, and 4 pints gruel, containing 1 tablespoonful cod liver oil	2	
9th week	4 pints gruel	2	
10th-11th week	5 pints gruel	2	
12th-24th week	6 pints gruel	2	
25th-36th week	Gradually reducing quantities of gruel, and increasing quantities of meal, chaff, roots, silage or greenstuff	2 then 1	

in the herd, and were then taken to the calf pens, where they were fed three times a day on a diet of boiled whole milk and cod liver oil, which was gradually changed to a home-made gruel as they grew older.

The exact dieting of the calves from birth to the age of 9 months is given in Table 3.

At the age of 6-9 months the calves left the calf pens and were transferred to other farms to make room for new comers.

Up to date 96 heifer calves have been successfully reared in the above manner. The rearing of the calves has been entrusted to an old cowman, who from experience has now reduced the actual procedure to almost a fine art. The calves throughout have appeared to thrive and grow, and the glossy appearance of their coats (possibly produced by the cod liver oil) has often been remarked upon.

Two minor troubles only have manifested themselves. The first appeared when an attempt was made to substitute a commercial brand of cod liver oil for the more expensive pure medicinal oil. The calves steadfastly refused to take the former. On several occasions the sudden change from the dam's milk to the cod liver oil diet has caused scouring, but this has been found rapidly curable by the use of the latest proprietary internal antiseptic.

In the spring of 1923 the first six calves reared in the above manner were subjected to the tuberculin test, with the result that two out of the six reacted; of the next 33 tested in the following autumn, all passed the test. It should be noted that the two which reacted to the test in the spring were actually the first two calves reared on the lines shown in Table 3, and, consequently, at a time when the procedure was only in its experimental stage.

In the autumn of 1923 there were tested, together with 33 heifers reared on the cod liver oil method, 4 reared on the Grade-A method. These latter had been fed on milk from the "free" herd, and subsequently with gruel as in Table 3, and none of them reacted to the test. In order to demonstrate that the boiled milk and cod liver oil method of calf rearing is as good as the Grade-A method, the calves reared under these two systems were mixed together at the time of testing, and several independent judges were asked to distinguish them without success.

It may be argued that it was unnecessary to resort to the cod liver oil method when milk from non-reacting animals

was available. There were, however, three very valid reasons for its adoption. (1) The first was geographical—the Grade-A herd being nearly three miles from the calf pens. (2) There was a shortage of Grade-A milk, and an increasing demand for it had been acquired. (3) The chief reason was that the writer was anxious to obtain by the sale of Grade-A milk an immediate and tangible return for the money spent on the tuberculin test.

The results obtained so far with the calves leads the writer to hazard the following conclusions:—

- (i) That it is quite practical consistently to rear non-reacting calves from reacting cows.
- (ii) That there is comparatively little risk of a calf contracting tuberculosis by being left on its reacting dam during the first four days of its life, provided there is no unsoundness of her udder as far as can be ascertained by clinical examination.

Final Conclusions and Suggestions.—It would appear possible to build up in a comparatively short space of time a herd free from tuberculosis, provided that adequate and thorough preparations are made, and that each subsequent step is carried out with a rigorous attention to detail, both by the veterinary surgeon, and those in charge of the animals.

From experience gained with the large number of animals dealt with during the past two years, the writer would suggest to owners of pedigree herds, in order to save themselves anxiety, disappointment, disillusionment, and money, that the initial steps should start from the bottom (the calves) and not from the top.

In a herd the greatest infection and susceptibility coincide with the time of greatest stress in the animal's life, namely, from the time it actually enters the milking shed after dropping its first calf. It is reasonable to suppose, therefore, that a lesser degree of infection exists among the calves and young heifers.

Should encouraging results be obtained with these, the owner may be tempted to test his cows; if not, the latter should be left alone, and all efforts concentrated upon the progeny. The immediate separation of the non-reactors from the reactors, and the establishment of the former in buildings which have been thoroughly aired and disinfected, has proved successful in the writer's case; nor does there appear to be much fear of infection from pasture which has remained unstocked through a winter.

The danger of a "flare up," *i.e.*, the sudden reappearance of the disease among animals considered to be "free"—which has probably done more to discredit the tuberculin test than anything—can only be guarded against by the most scrupulous and skilled application of the test, and the most accurate interpretation of the results obtained from it. The veterinary surgeon, and all his helpers, should be informed that the goal is the creation, and the permanent establishment of a "free herd," not merely the thorough application of the Ministry of Health's regulations. Unless this point is particularly emphasised, the cowman, in his anxiety to ensure the retention in the herd of a favourite cow, may be tempted to employ any of the ill-conceived devices, which are all too well known, to achieve his object. By so doing, he not only thwarts the owner's efforts, but intensifies the already difficult task of the veterinary surgeon, and stores up prolonged trouble for himself. The veterinary surgeon, too, who errs on the side of leniency in order not to offend the susceptibilities of the owner, must expect to meet with disappointment when carrying out subsequent tests.

Two years may be thought all too short a time to judge as to the permanency of the results obtained in the case under discussion. The writer, however, accepts the results as the greatest encouragement to proceed on the same lines, even if there should be occasional setbacks—a possibility that is recognised but not anticipated.

Further, he wishes to emphasise the fact that in the above description he is dealing with the subject entirely from the layman's point of view. He does not wish to claim the introduction of anything startlingly new, but rather to set on record the results of two years' work, with the hope that it may act as a guide to owners of pedigree herds.

Apart from the public health point of view, he is convinced that the trouble and money expended have already been amply repaid by the improved general health of the animals in his charge.

SOME POINTS CONCERNING PIG-KEEPING.

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DURING the past few years the breeding and feeding of pigs has probably received greater attention and aroused more interest than any other branch of farming, and if pigs have been kept on sound and economic lines they have returned a good rate of interest on capital invested in them. It is true that at the present time prices both for pork and bacon are comparatively low, and this has re-acted on breeding sows and young pigs, and the temporary depression has led to a tendency to dispose of breeding stock.

There is no branch of farming which fluctuates more than pig-keeping, and pig keepers, unless their work is combined with the production of other goods, must inevitably experience these periods of depression. An exceptional factor which has further tended to depress the price of pigs has been the large number of regulations which were necessarily enforced owing to the prevalence of foot-and-mouth disease. This has dislocated markets, and prices have consequently been low. Fluctuations in pig-keeping in the future, as in the past, are likely to continue, but possibly not to such a marked degree as hitherto if the movement to erect bacon factories continues. The present temporary depression does not indicate the possibilities, or even the probabilities, of pig-keeping when systematically carried out over a number of years.

Prices should not be judged on the returns from one year, but from a number of years. The pig keeper who has invested all his capital in pigs may not be in a position to wait for a favourable turn in the market, but at the same time it is not wise to commence pig-keeping unless allowance is made for these periodic depressions.

A number of small farms and holdings have sprung up, devoted almost solely to the keeping of pigs, and in most cases such holdings have consisted almost entirely of grass land. There has, perhaps, been a tendency amongst certain of those who have recently commenced to keep pigs to imagine that there is some "short cut" to success—that if they adopt the open-air system, or use feeding stuffs rich in vitamins, or include in their rations a number of mineral substances, they will be able successfully to run a pig farm. These are all factors of con-

siderable importance, but pig-keeping, like any other branch of farming, depends on a combination of these factors rather than a system which pushes any one of them to an extreme.

As far as is practicable, the different points in this article are based on the practice followed at the East Sussex County Council Farm at Plumpton, and on observations made on other holdings where a number of different systems of pig-keeping are followed.

Fluctuations in Prices.—With stock capable of increasing with such rapidity as pigs, prices must inevitably fluctuate over wide limits; but, apart from the usual seasonal variations experienced, if the total sales and receipts are kept over a period of years, it is surprising how consistent they remain. As an example, the sales at the East Sussex County Council Farm during the year 1920-21 amounted to £1,434, the following year £1,931, and the following year £1,726. During that period approximately the same number of breeding sows were kept, so that the total receipts over a 3-year period are very consistent. For consistency they compare quite favourably with the returns from a herd of milking cows, and more than favourably with the returns from the corn produced and potatoes grown. During the year 1922-23 accurate accounts were kept of the amount and cost of food utilised. The cost was £1,279, and was made up as follows:—

				£	s.	d.
2 tons 5 cwt.	Maize Meal	...	...	19	8	1
1 " 15 "	Maize Gluten	...	...	16	3	9
	4 " Butter Beans	...	...	1	16	1
68 " 6 "	Sharps ...	...	...	546	8	0
7 " 3 "	Meat Meal	...	...	116	3	9
	10 " Wheat	...	...	4	0	0
	41 gal. Cod Liver Oil	...	...	7	17	2
2 tons 3 cwt.	Fat	...	...	63	11	4
	3¼ " Fish Meal	...	...	3	8	3
17 " 7 "	Mangolds	...	...	13	0	3
36 " 11 "	Barley Meal	...	...	383	15	6
	Greenmeat	...	...	0	10	0
26 " 12 "	Potatoes ...	...	...	66	10	0
	16 " Dried Yeast	...	...	10	2	0
	2½ " Palm Kernel Meal	...	...	0	18	9
3840 gal.	Whey	...	...	16	0	0
1 doz.	Patent Food	...	...	0	1	10
2¼ cwt.	Dried Milk	...	...	6	0	0
36 churns	Separated Milk	...	...	3	12	0
				<hr/> £1,279 6 9 <hr/>		

It was found that the work relative to pig-keeping necessitated labour equivalent to $1\frac{1}{4}$ men. It should not be assumed, how-

ever, that the difference between the cost of food and labour and the sales is an indication of the profit which may be made. Although during the period the capital value of the herd increased considerably, it is quite possible that during a year of depressed prices the sales may barely meet the expenditure.

Open-Air Pig-Keeping.—It has been pointed out that no one factor in pig-keeping is likely to ensure success, but there is little reason to doubt that there has been no single factor of greater importance during recent years in connection with the breeding and feeding of pigs than the increased tendency to give them a more natural open-air life than formerly. At the same time it may not be desirable always to adhere solely to this system. On the average farm or holding where buildings and sties are available, it would be uneconomic not to utilise them fully. Beginners at pig-keeping are usually more successful when breeding and rearing on the open-air system than when using sties. Fresh air and sunshine are, of course, as vital to the pig as to any other class of farm animal, and the outdoor system makes these essentials more easily accessible than does a system dependent on the use of sties. Again, the open-air system usually enables pigs to obtain green food and incidentally those elusive substances, vitamins, which have loomed so largely in the pig keeper's mind during recent years. At the same time mineral matter, often deficient in the ration of the sty-fed pig, is usually easily obtained by pigs running in the open air. Fig. 1 shows a herd of breeding sows run on the open-air system at the County Council Farm, Plumpton.

Pig-Keeping in Woods.—This system has recently, and possibly more in East Sussex than in many counties, been largely practised, and its success justifies the contentions advanced by those who advocate it. It is, of course, reasonable to expect that a system of pig-keeping which so nearly approaches the natural conditions of the ancestral animal should be successful.

The most important argument to be urged against this system is undoubtedly the loss of manurial value of the food. The value of pig manure is widely appreciated on the farm and its loss amongst the underwood is a factor of no small importance; but on the other side the factors in favour of keeping pigs in woods are so great that in the writer's opinion they outweigh the loss of manurial value. From observations at the County Farm and elsewhere, he is strongly of opinion that, other conditions being equal, pigs having a moderate run of woodland are invariably healthier and do better than those kept in other



FIG. 1.—Groups of Sows at the East Sussex County Council Farm, Plumpton, run on the open-air system.



FIG. 2.—Poor Grass Land improved by Basic Slag on the right, untreated on the left. The growth of White Clover coincides exactly with the track of the manure distributor.



FIG. 3.—A group of Gilts before farrowing.



FIG. 4.—The same Gilts with their litters before weaning.

conditions. The shade afforded in the summer and the equable temperature prevailing are factors of the very greatest importance, whilst during the winter period the shelter afforded by the wood induces pigs to leave their houses when but for this shelter they would remain in their huts or hovels.

Again, in the woodland there is no necessity to ring the pigs, so that they obtain a considerable quantity of mineral and protein matter. On the other hand a number of novices have wrongly imagined that pigs kept in woods find there the greater part of their food. They may do so under exceptional circumstances for a very short period during the autumn months, but if success is to be obtained from this system regular rations must be provided. It is most interesting to note that, although the acreage of wood in question is small, there is very little tendency indeed for the pigs to wander from it. Other than the natural fence, no fencing of any kind or description is used. The gilts and sows lie in an open hovel and have free access to the wood. It is considered a matter of importance after gilts and sows have farrowed, if they have been kept on this system, to restrict their range shortly after farrowing, otherwise the young pigs do not seem to obtain a regular supply of milk, and suffer in consequence. It is also desirable for the sows or gilts to farrow in a shed and not in the wood.

Pig-Keeping on Restricted Areas of Grassland.—Although the pig is an animal which can utilise rough poor land, it is a mistake to think that pigs do not appreciate and benefit from good grassland, and the better the grassland and herbage the better will be the breeding sows and their offspring. The writer has invariably found that on grassland which has been improved the breeding stock do not need any addition of mineral matter and thrive well on a balanced ration provided that the necessary amounts of protein, carbohydrates and fat are available. Undoubtedly mineral matter plays a most important part in connection with the rearing of young stock, and there is no cheaper way of supplying it either to pigs or other stock than by a dressing of slag and kainit on pasture land. Fig. 2 shows part of a field which has been improved, and it has been found that the improved parts are as attractive to pigs as to any other class of stock.

On a number of small holdings devoted almost entirely to pigs there is often a considerable waste of grass and also of

the manure produced by the pigs. Liming of such enclosures does not seem to benefit them so much as might be expected. It appears to render the nitrogen from the manure more easily available and to encourage, rather than to check, the rankness of such over-stocked pig land. On the other hand a dressing of slag and kainit undoubtedly tends to check this rank growth.

The degree of immunity of pigs to diseases associated with dirty conditions is proverbial, but it is certain that much of the loss amongst sty-bred pigs is due to such diseases, and it is a matter of no small importance for the pig-keeper on a restricted range of grass land to consider how long it will be before these restricted areas become "sick of pigs." Unless they are improved by the addition of mineral matter they undoubtedly tend to become deficient in minerals, and must almost certainly become infested with parasites of various kinds.

In the County of East Sussex many thousands of Romney Marsh sheep are brought inland from the Marshes. They are renowned for their hardiness and their value for utilising rough grass land. They feed well on grass land where pigs have been run, and it is undoubtedly a most economic combination to stock such grass land with sheep during the winter months.

Sty Feeding and Breeding of Pigs.—In the western counties on dairy farms sty-feeding and breeding of pigs has been practised most successfully for years. indeed it is doubtful whether for practical fattening purposes a more ideal system could be found than the sty-feeding of pigs on whey and barley meal. This ideal combination of food has undoubtedly helped to produce much of the famous Wiltshire bacon, and generally on such dairy farms where dairy by-products are available, many of the difficulties experienced in connection with sty-fed pigs do not arise. Dairy by-products seem to supply the necessary mineral and other matter, so that it is chiefly on the cottage holding and on the farm where dairy produce is not available that sty-fed pigs thrive least. It is undoubtedly more difficult to rear and breed pigs when confined to sties than when kept on the open-air system, but the writer is still of opinion that sties, where available, should be used, though the rations fed to such pigs must be more varied and of a more generous nature than those fed to pigs running in the open.

Condition of Gilts and Sows Before Farrowing.—There appears to exist amongst a wide class of pig breeders an idea that breeding pigs should be kept in what is popularly termed "store" condition before farrowing; but it does not generally

seem to be appreciated that if the best results are to be obtained from breeding sows they must be in such a condition as to enable them to produce an abundant supply of milk for their litters. Fig. 3 shows a group of gilts at the County Farm, Plumpton. A number of pig keepers were of opinion that they were in too high a condition, but results and not opinions should surely be the guiding factor in deciding such a question. Seven gilts were farrowed down, including those shown in the illustration. They had all been similarly fed and were in identically the same condition. The 7 gilts farrowed down during the winter months were not supplied with any dairy by-product, and successfully reared 50 young pigs. Fig. 4 shows the gilts with their various litters just before weaning. It will be noted that despite the winter season the young pigs are big, alert and vigorous, and considerably above the average size of such pigs usually reared during the winter. There is no more wasteful form of pig-farming than to keep sows and gilts in an under-fed condition. It is useless to imagine that generous feeding after the young pigs are born can remedy insufficient nutrition before farrowing. It is of the greatest importance, however, that the condition shall be that of "fitness" rather than of "fatness," and that the ration used should contain a high proportion of protein. Owners of heavy milking cows do not generally allow their dry cows to get into "store" or poor condition; they realise that if high records are to be obtained the cow must be in good condition before calving. The same undoubtedly applies, but has not been generally recognised, in connection with pig-breeding and feeding. The ration generally used on the County Farm for in-pig gilts consists of 10 per cent. of meat meal, 60 per cent. of sharps, and 30 per cent. of barley meal; and although a large number of other rations and combinations have been tried it is still considered to be one of the most economic and satisfactory rations that can be used, always provided that the ingredients are of good quality.

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NOMENCLATURE OF GRASSES AND CLOVERS.

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A CONSIDERABLE amount of confusion occurs as the result of the numerous descriptive terms that are often applied to grasses and clovers. It is much to be desired, therefore, that the terms in common use should be reduced to a minimum, and that these terms should be defined as accurately as possible, and each only used in its proper connection.

It is the purpose of this article to endeavour to give as precise a meaning as possible to those terms which it is desirable should be retained and generally used.

Nationality and Strain.—The majority of grasses and clovers, being cross-pollinating plants, do not attain to the same state of purity as crops like oats and wheat. It is none the less a fact that seed obtained from any particular source is likely to give rise to plants which, although differing widely amongst themselves, in the aggregate do conform to some general group characteristic. Thus the herbage produced on a plot sown with one lot of seed may have quite different general characteristics from that developed on a plot sown with another lot.

It is customary to speak of a group of plants conforming to some general characteristic as constituting a strain, and it is in this connection that "strain" has come to be applied to grasses and clovers. Thus "strain" does not imply the same high state of purity, or the ability to breed absolutely true, as the term "variety" in wheat or oats.

The "nationality" of a sample refers to the country where it was grown for seed, and as applied to herbage plants must not be taken necessarily to have any profound significance. It so happens, however, in the case of red clover and of several grasses, *e.g.*, cocksfoot, that seed grown in certain countries does tend to give rise to plants conforming to certain salient characteristics which can be definitely anticipated. This is true in a marked degree of Italian red clover, American mammoth red clover—and indeed of most of the nationalities of red clover, and of Danish, French and New Zealand cocksfoot.

In these cases "nationality" and "strain" are practically synonymous, and hence of course the importance and value to the farmer of the nationality clause in the Seeds Act.

It has come about also that local strains have been given district names. We hear, for instance, of Hampshire sainfoin, Montgomery red clover, Oxfordshire red clover, Vale of Clwyd red clover and the like, and all that is definitely implied (and practically guaranteed) by such descriptions is that the particular parcel of seed so referred to was grown in the district stated. The point here to be emphasised is that descriptions such as the above do not necessarily imply a guarantee of any sort as to strain. The Hampshire sainfoin might be giant French "once-grown," or it might be a fine and persistent strain of "old English." The Montgomery red clover might be Chilian seed "once-grown" in Montgomery, or it might be a fine extra late and persistent strain grown for generations in Montgomery. We see then that locality descriptions may mean everything or nothing as to "strain," and it should become customary to qualify the locality description by the description of the strain which the parcel of seed represents. It will, therefore, be desirable to endeavour to give a description of those strains of the chief herbage plants which are at present commercial commodities, and to select from amongst the numerous descriptive phrases in common use those which are the most applicable and definite in their meaning.

First, however, it is necessary to settle what certain of the descriptive terms should mean, viz.: "stock seed," "wild or indigenous," and "harvest year."

Stock Seed.—In the production of the seed of roots and vegetables great precautions are usually taken to ensure the purity of "stock" seed—that is to say of the seed which will be employed to sow the larger area for the production of pure seed for distribution.

It is unfortunate that in so far as grasses and clovers are concerned but little attention has been paid in the past to the question of stock seed. The term may, however, be used in the same sense as when applied to roots and vegetables.

Wild or Indigenous.—The terms "wild" or "indigenous" as applied to seed have been used to indicate that the seed has been harvested from old permanent grasslands or from waste places.

The term "wild" as applied to white clover has been in use for a number of years, and it is now generally realised that wild white clover is a definite strain. Wild red clover is also to a limited extent a commercial commodity. Quite recently wild or indigenous cocksfoot and some other wild grasses have also found their way on to the market.

A distinction has been made between ordinary wild white clover and "once-grown" wild white clover, and this is a distinction that should always be adhered to by vendors and insisted upon by purchasers, the more so since "wild" seed of sundry grass species is taking its place alongside wild white clover. "Wild" as applied to seed has been taken to imply, and should only be applicable to, seed actually harvested from old permanent swards or from waste places. The term as thus defined has a very real strain significance and indicates that the seed is likely to give rise to plants which will be far more persistent and aggressive under conditions of competition than non-wild seeds.

"Once-grown" wild seed is seed that has been harvested from a ley sown down with stock seed obtained direct from an old permanent sward. Seed harvested from such a ley and again sown to develop a seed-producing ley would give rise not to "once-grown" but to "twice-grown" seed. The term "once-grown" is therefore only applicable to the direct and first generation progeny of permanent sward seed, but unfortunately the term is by no means always used in this correct sense, "twice-grown" or "three-times grown" seed being on occasion referred to as "once-grown" or sometimes even as "wild"!

In this connection the writer would suggest the desirability of the word "wild" only being used to refer to seed actually harvested from old permanent swards, and "indigenous" being used when supplies of seed derived from an "indigenous" stock are developed by a process of growing on. Thus wild white clover would retain its definite meaning and would be applicable only to old sward seeds. "Once-grown" wild white clover should then be referred to as "*once-grown*" *indigenous white clover*.

In the case of grasses like cocksfoot the wild or indigenous seed on the market will seldom, if ever, have been taken direct from old sward or waste places, but will always have been once or more grown on. It should therefore be referred to as "indigenous," "once-grown," "twice-grown," etc., as the case may be.*

This would be a valuable distinction in the case of perennial ryegrass—the seed cleaned from wild white clover harvested in Kent would legitimately be described as "wild perennial rye-

* The above distinction between "wild" and "indigenous" would be valuable even if "indigenous" were taken merely to imply "grown on" without any qualification as to the number of generations.

grass," while that grown on from selected indigenous stocks would be "indigenous perennial ryegrass."

NOTE.—The evidence so far available suggests that there can be little or no objection to "growing on" wild seed—provided reasonable precautions are taken to isolate the growing-on leys—and (or) by methods of control to bring them to flower at a different date to adjoining fields.* It must be remembered, however, that old sward conditions will have made for a selective influence in favour of plants of marked persistency, while the taking of seed from young leys tends to exert an influence in the opposite direction.† It is therefore very desirable that "once-grown" seed of a persistent plant like wild white clover or a persistent indigenous strain of rye grass or cocksfoot should not be taken in the first harvest year—but always deferred until the second or, preferably, the third or fourth harvest year—and that stock seed should always be obtained from an old sward in the case of "wild" plants, and from carefully isolated and re-selected stock seed areas in the case of "indigenous" plants. Thus "once-grown" wild seed is always to be preferred to "twice-grown," and the same is true of indigenous seed, unless there is some very definite assurance that the methods of seed production employed have been based on sound scientific principles.

Harvest Year.—The "harvest year," i.e., year in which seed is taken, is of great importance, not only in the case of the persistent wild strains but also in the case of other persistent strains—such as old English sainfoin and the late-flowering red clovers. In the opinion of the present writer stock seed of old English sainfoin and of the more persistent late-flowering red clovers should always be taken from leys that have been down for the greatest possible number of years, and, when possible, seed for distribution should be taken subsequently to the first harvest year.

It is urged that it should become a common practice to refer to the harvest year in the descriptions that accompany seeds for sale. The writer would be prepared to give more per pound for seed of once-grown indigenous white clover harvested in the third harvest year than for seed from the same ley harvested in the first harvest year, and more for Montgomery red clover harvested in the second harvest year from stock seed off a ley four years old than for Montgomery red clover harvested in the first or even the second harvest year from stock seed harvested in a first harvest year.

There can be little doubt that as the question of strain and methods of seed production in relation to strain become better

* Wild White Clover and Indigenous grasses normally tend to flower later than their commercial counterparts.

† See also Stapledon, R. G. : Strains of Herbage Plants, in the Year Book of the Essex branch of the National Farmers' Union, 1924.

understood, there will be an increasing demand for "once-grown" seed, not only of indigenous white clover but of numerous indigenous grasses, and that those farmers who take the wisest precautions to safeguard the purity of their stocks will obtain the best prices for their seed. The purchasers, however, should be informed precisely what those precautions have been, as applied both to the seed of distribution and to the stock seed.

Definite Strains of Herbage Plants.—Apart from the distinctions between wild white clover and white or Dutch clover which are now generally realised, and the important distinctions that can be made in respect of red clover, at present "strain" has not attained to great significance in relation to herbage plants. It is evident, however, that the time is not far distant when various strains having definite properties will be available in the case of numerous species. It is much to be hoped that such strains when made available will be accurately defined in terms of important agricultural properties such as persistency, leafiness, suitability for hay or pasture conditions, and the like. The need for clear definition devoid of all ambiguity is well exemplified by the confusion that obtains relative to red clover. concerning which species the following notes may be found useful.

Red Clover.—The cultivated red clovers fall into two groups—the early-flowering and the late-flowering. These two groups are as distinct from each other as are winter and spring oats, and each group contains a number of more or less clearly defined strains. All cultivated red clovers should be referred to as either (1) broad red (=the early red clovers), or (2) late-flowering red. Late-flowering red clover is often known as single-cut cowgrass, but since "cowgrass" is frequently used with reference to broad red clover it would be a great gain if the ambiguous word "cowgrass" could be entirely dropped, when such descriptive terms as "giant hybrid cowgrass," also meaningless, would fall into disuse.

It is not necessary here to give detailed particulars of the various strains of broad red clover and of late-flowering red clover.* It may be stated, however, that the former group constitutes those strains which are more definitely biennial, flower early, aftermath well, produce a considerable amount of keep in the autumn of the seeding year and come into luxuriance com-

* See Stapledon, R. G., and Williams, R. D., "Red Clover," this *Journal*, Vol. XXX, p. 239; Williams, R. D., "Red Clover," Bull. H. No. 1, Welsh Plant Breeding Station; and Williams, R. D., "Strains of Red Clover," a Paper read at the Aberystwyth meeting of the Agricultural Education Association, see *Agricultural Progress*, Vol. I, 1924, p. 50.

paratively early in the spring of the first harvest year. They are not as a rule persistent. The late-flowering group consists of those strains which flower late, do not aftermath as well as the broad reds, produce less in the autumn of the seeding year and start growth later in the spring of the first harvest year. They are, however, more persistent than the broad reds. Certain strains are extra late to flower, extra close growing in the early spring, and exceptionally persistent. Such a strain is, for instance, the Montgomery red (using "Montgomery" in the strain sense). A strain of this sort should therefore be described as "Montgomery extra late-flowering red clover," if the seed was harvested in Montgomery; while if the seed in question had been grown in Essex from stock seed obtained from Montgomery it should be described as "Montgomery extra late-flowering red clover once-grown in Essex," and particulars as to the harvest year of both the stock seed and the distribution seed added.

In conclusion, it seems desirable strongly to urge farmers, seed growers and seed merchants alike to insist upon the adoption of a standard nomenclature as applicable to seeds, methods, and places of seed production, for unless this is done the confusion will become intolerable, and the benefits resulting from the production of relatively pure and improved strains will be largely lost to the agricultural industry as a whole.

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AN EDUCATIONAL EFFORT AT AN AGRICULTURAL SHOW.

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IN view of the preparations now being made by agricultural societies for the show season, it may perhaps be useful to give some account of an effort made by the Three Counties Society last year, at their show at Malvern, to interest the rising generation in the importance of agriculture to the nation.

Arising from a chance suggestion made at a meeting by the Hon. Mrs. Wilmot, of Earl's Croome, near Worcester, who is herself a keen agriculturist and a practical and successful small holder, the Council of the Society offered to give facilities for the attendance of children from the elementary schools in the Three Counties (Gloucestershire, Herefordshire, and Worcestershire), provided that they were accompanied by their teachers, and that some effort was made to make the visit instructive as well as entertaining. The result was as interesting as it was unexpected. It was thought probable that perhaps 200 or 300 children would

attend, but no fewer than 1,000 children from 13 schools, mainly of course in the neighbourhood of Malvern, attended the show in this way.

Careful preparations were made for their reception and instruction. In the first place, the approval and co-operation of the County Council and of the Board of Education were sought and readily obtained. After a discussion of the matter with the Inspector of the Board of Education, a proposal was submitted to headquarters to the effect that the visit should be allowed to count as school attendance, and this proposal was approved. This is a matter of no small importance as it makes much difference to the outlook of the teachers and of the county authorities with regard to such a visit, having in view the education grant. At the same time the County Director of Education was consulted, and he readily gave every facility for the necessary organisation from the County Council standpoint. He kindly arranged for a meeting of the teachers who had signified their willingness to attend the show and bring their children, and in other ways made matters easy for the society's representative to whom the work of organisation was entrusted. The latter met the teachers and gave them particulars of the proposed programme to be followed and of the general idea in the mind of the council as to the working of the scheme and the instruction of the scholars.

This meeting was well attended and evidently greatly appreciated by the teachers, to whom the idea was entirely new, and some of whom were not well versed in agricultural matters. Further, a detailed itinerary was drawn up, with short notes upon the matters of interest to be specially noted at the various places to be visited. Thus in turn the children were taken to see the stands both of the local and of the more widely known dealers in and makers of farm implements; this was followed by a visit to the very interesting exhibits of the Malvern Public Health Committee and the Women's Institutes. The flower show, working dairy, seed, cake and manure firms followed: a glimpse was afforded of the opportunities offered overseas by the Canadian Government, and then the groups of children went on to see the stock.

With regard to the latter, brief descriptions of the principal purposes of the breeds exhibited had been prepared and printed and put up at the ends of the sheds, and each teacher was provided with a copy of these particulars. It may be of interest to quote one or two examples:—

HEREFORDS.—A beef breed, classed with the black Aberdeen-Angus as the best for that purpose. The young cattle come to maturity very early. Hardy, and very popular in America (North and South), South Africa and Australia.

SHORTHORNS.—There are two types—the beef and the dairy Shorthorn—and this is thus a dual-purpose breed. The vast majority of ordinary cattle in England are cross (or partly-bred) Shorthorns. Largely exported to North and South America.

JERSEYS.—Share with the Guernsey the pride of place as a butter producer. A native of the Channel Isles, where the normal stock varies from 11,000 to 12,000 head. Very popular everywhere that climate suits. The milk contains a common average of 6 per cent. butter fat. Much hardier than commonly supposed.

DEXTERS.—The smallholder's cow. These wonderful little cattle are about as hardy as goats, and the best of the breed are excellent milk producers. The smallholder and the farmer with poor grass-land should give consideration to this breed. The cows cross particularly well with other breeds for beef or milk production.

It was not thought desirable to limit in any way the time which the children should spend at the show, because it was felt that they would be disappointed if they had to leave before the usual show-ring attractions took place. Their attendance was, however, confined to the second and third days, with a view of keeping the ground free during the judging day. It was felt by the Council that some charge ought to be made, and they fixed the amount at 3d. per head, provided that tickets were applied for and obtained beforehand, so as to avoid crowding at the turn-stiles. The teachers themselves were presented with complimentary tickets.

There is no doubt that the whole experiment was thoroughly justified by its success. As has already been mentioned, over 1,000 children attended, and that they really learnt something was put to the proof by the private offer by the Society's representative who organised the visit, of prizes of one guinea and half a guinea for the best essay on the Importance of Agriculture to England, open to scholars who attended the show. Each teacher was asked to submit the best one or two of the essays written by his or her pupils, and these picked essays were then sent to the donor of the prizes for final adjudication. They were extraordinarily well done and clearly showed that the teachers had spent both time and trouble in bringing home to their scholars the lessons to be derived from their visit to the show. Permission was obtained to publish the prize-winning essays, and one is reproduced here.

The first prize was won by Dorothy Davies, aged 13, of Leigh Sinton School, whose essay was as follows:—

"Agriculture is the oldest industry in the world and at present the most important. Right up to the middle ages, agriculture formed the chief occupation of the people, every man growing enough for himself and his family. But when manufactures came to England, factories and towns sprang up and people left the villages to go to the towns, leaving less people to cultivate the land, but swelling the number that needed the country folk to supply food for them. People still leave the villages every year, and the population of the countryside is decreasing, so that we find the majority of England's people in the towns.

Yet, do these town-people consider, when they come to admire the beauties of the countryside at holiday-time, that they owe all they have to the country and the farmers, that their clothing, food and shoes came in the first place from the countryside? Do they think either that the raw materials for the factories they work in come from the farmers of England and other countries, and that the farmers are really the foundation of a great many industries? The wool and cotton and leather all provide raw materials for manufactures, and the animals and vegetables, fruits and corn, provide food for those who work at the manufactures.

But if the whole of England was laid out for agriculture and cultivated properly, it would not supply enough food for the needs of England's great population. Agriculture is not so simple as it looks, and men must study hard if they wish to know all about it. All farmers are not agriculturists, but they help to grow food for the townspeople. Some farmers found that last season the wheat did not pay back very well, and are not growing so much.

It can easily be said of England that she is one of the foremost countries in the production of good, fine, standard breeds of cattle, and her sheep are very fine, some breeds being unrivalled. Pigs and poultry, too, often gain high awards.

Just to show what can be done in these and other respects and to keep up the proud interest in agriculture and stock-breeding, shows are held and awards offered for the finest animals. To cultivate the land well and to be able to look after his animals a farmer must pursue the new and up-to-date methods that men are continually inventing, all to better agriculture, and he may learn these methods at a show.

Here men meet from all over the country to exhibit their machinery and animals and show their new methods. One item of the Three Counties Show, given great attention, was clean milking, which showed great improvement on the ordinary method. It showed how to prevent the deaths of so many children from drinking unseemingly, filthy milk, that was really full of germs. It told how a dairy should be kept, and expounded some men on the way they milked cows with their filthy hands.

At a show like this all the best of everything is exhibited. Farmers find new sorts of vegetables, new breeds of cattle, fresh kinds of poultry, and flower-fanciers invent different kinds of brightly-hued flowers. New inventions in the shape of machinery are shown, and other countries exhibit their produce on a small scale. At the Great Show a good deal about Canada could have been learnt by looking at a covered-over stall, called 'Canada's

Productions,' where everything grown in Canada was represented by a small piece of each.

Another thing that attracted many was a man lecturing on bees, who showed several hives of bees, and he himself was covered with them till he was hardly discernible.

I had never seen such beautiful cattle, sheep and pigs, poultry and goats, horses and flowers, as I saw there. Monstrous bulls and cows were shown, and the wool on some of the sheep was three or four inches deep, while others' wool was like fine silken hair that curled beautifully.

There were a great many other attractions, all interesting, and, on the whole, I am sure the show did a great deal of good, and besides interesting people taught them as well."

Two or three gems from the writers of unsuccessful essays are worth quoting. They were given in the *Worcester Herald* for 10th August, 1923. For example, one boy of 14 years wrote:—

"Nowadays the school children have a great many more chances to learn than their grandparents, or even their parents. When the children come running in and say that they are going to the Three Counties Show with the school, the old grandfather murmurs: 'We never had such treats in our time at school.' No! the educational point of view is different now from what it was in those days. Teachers of to-day think that their pupils can learn better if they see what they are being instructed about. If children see anything that interests them in their early life, they generally keep it in their mind's eye, and perhaps in later years try to improve upon it."

Another boy of 13 years wrote:—

"The modern farmer is an Atlas up-to-date, bearing the world upon his shoulders. He is head of the world's larder, always striving to keep it well stocked to meet the needs of a great community. He cultivates the soil, he gets good crops by careful selection of his seeds beforehand, and in various other ways helps on the work of agriculture. In the late Stone Age tools were scarce, and people were few; therefore, a barren wilderness resulted. The British Isles are surrounded by water, and they depend entirely upon the Colonies for food. The farmers do not grow enough to feed the nation."

Just a final quotation from the paper by a 12-year-old girl:—

"There was a lovely new geranium called Fascination, and it would be a funny world if God had not made any flowers."

In addition to the facilities offered to the elementary schools, somewhat similar opportunities were afforded by the Council to the scholars at the Malvern College and the many other large schools for which Malvern is famous. There are some 2,000 children attending such schools in Malvern, and the Council allowed the scholars to come to the show at any time at half

price. That this concession was appreciated was shown by the fact that at one time there were on the show ground no fewer than 500 boys from the College alone. Parties of these boys were organised at their own request, and they were taken round the ground by well-known agricultural experts, who took pains to make their visit of real value.

For the reassurance of show authorities who may contemplate following the Three Counties Society's lead, it may be mentioned, first, that a very substantial sum accrued to the Society in gate-money, and secondly, that never was there any trouble through over-crowding or otherwise as a result of the visit of the children.

* * * * *

METHODS OF ORCHARD SOIL MANAGEMENT.

ERNEST M. BEAR.

PREVIOUS to the war the orchards of England, with very few exceptions, fell into two classes:—those under clean cultivation and those under permanent grass. These two main divisions still hold good, but the scarcity of labour during the war years, and its high cost since, have induced growers to make alterations in their methods of management. Many more orchards have gone down to grass, and various new methods of dealing with the herbage have been introduced. In most of the orchards which are still under clean cultivation new methods of tillage have been adopted for reasons of economy. In different orchards, both arable and grass, the systems of soil management are much more varied than formerly. The object of this article is to describe some of these systems, and to discuss their merits and their suitability to various conditions, climatic and otherwise.

Clean Cultivation.—Before the war the usual method of maintaining clean cultivation in orchards was to have the ground dug during the winter, and to follow this up throughout the growing season by horse cultivation between the rows of trees and hand hoeing in the rows. In the case of many plantations of bush-shaped or dwarf trees, planted too close together for horse cultivation, the whole of the work had to be done by hand. There is still no better system of cultivation; but in most cases growers have been obliged to find less expensive methods. The winter digging, or rather shallow forking over, used to be done

very cheaply by piecework, but is now naturally much more costly, even if men can be found willing to undertake it by the piece. Hoeing also, which must be done at frequent intervals during the growing season, if the land is to be kept clean, has become much dearer, so that growers are obliged to reduce to a minimum the area which can be worked only by hand.

New Implements.—Fortunately the situation has stimulated invention on the part of implement manufacturers. “Off-set” implements, such as have long been used in American orchards, have been introduced. These are so designed that they can work the soil under the branches, close up to the stems of the trees, whilst the horses and man walk clear of the branches midway between the rows of trees. There are, for instance, several patterns of fruit farm or plantation ploughs. These differ from an ordinary plough in having the head and handles adjustable, so that they can be swung out at an angle to the beam. The horses are attached by a single trace chain to a staple on the beam, and not to the head in the usual manner, the adjustable head serving merely as a guide and support to the trace chain. The breast is designed to turn a wide, shallow furrow-slice, as deep ploughing is neither necessary nor desirable amongst fruit trees. A disc coulter can be fitted in place of the usual knife coulter for ploughing grass land or where weeds are very thick. With such a plough it is possible to work right up to the stems of the trees, unless they are of the old-fashioned bush type, branching right from the ground level.

Ploughing in Orchards.—There are several ways of using the plough. The best is perhaps as follows:—If the land is weedy, first fork over by hand the narrow strip down each row on which the trees actually stand. Then plough towards the stems of the trees. This leaves a shallow furrow midway between the rows, which is useful for drainage. The following winter, in order to keep the land fairly level, plough away from the stems, and dig the narrow strip in the actual tree rows after ploughing. It is sometimes recommended that the land should be ploughed up to the trees in autumn and away from them in spring. This, however, doubles the labour, and involves more stirring of the soil with its risk of injury to the roots. Moreover, the second ploughing brings to the surface again any manure and weeds which were buried by the first ploughing. Still, the second ploughing is occasionally necessary after a wet.

mild winter in which the weeds have grown through the furrow seams and the land has been solidified by heavy rain and the trampling connected with winter spraying and pruning. Two ploughings are certainly not necessary for the sake of levelling the land. The summer work with cultivator and hoes does much toward this, and ploughing towards and away from the trees in alternate winters completes the process.

Whether the single ploughing should be done in autumn or in early spring is a matter which must be decided by local conditions. Land ploughed in autumn certainly lies drier during the winter. On the other hand, if the land is weedy, there is something to be said in favour of leaving the weeds as a cover crop to prevent the washing out of plant foods during the winter, ploughing them under in early spring. In practice, where there is much land to be ploughed, it is probably best to get the work done at such times during the winter as conditions are suitable and the horses are available.

Ploughing may not be essential every winter. When a dry autumn favours late surface cultivation, so that the land can be got clean before winter, it may be omitted, at any rate on some soils. It is unwise to do more ploughing than is absolutely necessary, as the less the roots are disturbed the better. It has been found that the greater part of the food-gathering roots of fruit trees lie between 4 in. and 10 in. below the surface. For this reason the plough should never go more than 3 or 4 in. deep. If this is kept to, it is doubtful whether ploughing does any more harm than shallow forking, and it certainly does less than deep digging.

Spring and Summer Cultivation.—Whether the land has been ploughed or not, surface cultivation should begin at the earliest opportunity after the soil becomes dry enough in spring. This does good at first by admitting air to warm the soil and start the processes which lead to the elaboration of plant foods; and, later in the season, a fine surface tilth or “dust mulch” does much to protect the trees from drought injury by checking the upward flow of moisture and its loss by evaporation from the surface.

For reasons of economy hand hoeing must be reduced to a minimum. Implements of recent introduction assist the grower in this direction. There are cultivators with adjustable head and handles, used in the same way as the plantation plough already mentioned. It is also a simple matter to fit a special disc rudder attachment to a spring-tined cultivator. Both types of culti-

vator have their uses, according to the condition of the ground; and both allow of the soil being stirred beneath the branches of the trees, leaving only very narrow strips to be hoed by hand. Indeed, where it is possible to cultivate in two directions hoeing may sometimes be avoided altogether. The spring-tined cultivator, which is very low, can be used even amongst bush-shaped trees which branch close to the ground.

Cultivation and hoeing are generally needed three or four times in the spring and early summer, and again a like number of times in the autumn, if the weather is dry enough. There is usually a period in the summer when cultivation is not much needed, and when it is undesirable on account of the branches being weighed down with fruit.

Many horsemen regard these newfangled off-set ploughs and cultivators as quite impossible tools. The writer can say from experience, however, that anyone can work them easily after a brief trial; and they make for the comfort of the man by keeping him clear of the branches.

Motor Cultivation.—Motors are used to some extent in place of horses in fruit plantations, and there is no doubt that they do much less harm amongst the trees. In Kent orchards small tractors are used to draw both ploughs and cultivators. Rotary soil-tillers are very useful for surface cultivation during the growing season, as they are narrow enough to pass between rows of bush fruits and low enough to work under branches about 3 ft. from the ground. Their chief value is to reduce hand labour, both digging and hoeing, rather than to replace horses where there is plenty of room for the latter to work.

Intercropped Plantations.—Most young orchards are intercropped until the trees grow large enough to shade the whole of the ground. If they are intercropped with vegetables, flowers, or strawberries, as is the custom in some districts, the cultivation must be such as is required by these crops, and need not be considered here. More generally, however, the young orchard is intercropped with bush fruits. In this case the space between the rows soon becomes too narrow for ploughing. It is better, in fact, to manage as far as possible, even from the start, with surface cultivation only, as bush fruits are shallow rooted. For a good many years a horse-drawn or motor cultivator can be got between the rows, and as long as this is possible there is no need for deeper tillage, though it is usually necessary to dig the actual rows. For a few years after planting, in fact, it is often possible to cultivate in two directions, in which case digging and hoeing

are confined to a small space round each bush and tree. The first cultivation in spring is often difficult, owing to the surface being panned down by the winter's rains. The writer knows nothing better in such conditions than a rotary motor tiller. It is possible, however, to do the work with a horse-drawn cultivator if suitable tines are fitted, those with chisel points being, perhaps, as good as any. Sooner or later there comes a time when the bushes fill the space so that horse or motor cultivation must cease, and there is nothing for it but to fork over the ground in winter and hoe it by hand in summer. By that time, however, the bush fruit should be yielding well enough to pay for such work.

Very thorough cultivation is, of course, essential for bush fruits, which quickly suffer from drought unless a mulch of fine soil is maintained during the late spring and early summer. Cultivation should start as early as possible in spring and be repeated whenever the surface tends to become either weedy or panned down. Nor should the work cease after the crop has been gathered, for a plantation which is not cleaned in the autumn by surface cultivation must be dug in winter to get rid of the weeds. By the time the bushes are worn out the permanent trees should be coming into full bearing. The bushes can then be grubbed and the orchard treated as described already.

Grass versus Cultivated Orchards.—As a general statement, it may be said that an orchard under clean cultivation is superior to one under grass. The fruit grows larger and is often of better quality, the flavour and texture of the flesh being more pleasing. This, however, is only a general statement. Much depends on the management of the grass orchard, also on local conditions of soil and rainfall. There is no doubt that a grass orchard is more liable to suffer in a year of drought. On the other hand, it is drier during a wet season and during the winter, which is an indication that grass is an advantage in a wet situation. There are circumstances in which grassing is harmful and others in which it is beneficial. If the trees are fruiting freely and not making any too much growth, grassing cannot be advised, as the trees are likely to go downhill. If, however, they are making vigorous growth, and particularly if they are making growth rather than fruit, grassing is likely to steady the growth and induce a more fruitful habit. Where leaf scorch is troublesome amongst apples, grassing sometimes proves a remedy. Though the fruit is generally smaller in a grass orchard than in one that is well cultivated, it invariably has a higher colour, particularly

in a wet season. Very often, too, it has better keeping qualities. It is an advantage to a grower to have some orchards under grass and others cultivated, as the two classes score in different seasons.

The kind of fruit grown has some influence. Plums are generally decidedly better on cultivated ground, whereas most cherry orchards are grassed. In the case of apples and pears, standard or half-standard trees on free-growing stocks are more suitable than bush-shaped trees for a grass orchard.

It is the question of expense, however, which has prompted so many growers in recent years to grass down their orchards. They contend that, even if the fruit is not always of such high quality, it pays better owing to the reduced cost of production. As a matter of fact, there are plenty of instances, under modern methods of management, in which the fruit is of superior quality in grass orchards in all but seasons of severe drought. It cannot be too strongly insisted, however, that an orchard must be well established before it is grassed down. Clean cultivation is essential for at least seven or eight years after planting, and better still for ten or twelve. Nothing is more prejudicial to the growth of newly-planted fruit trees than having turf over the roots, as may be seen from examples in every district. The trees simply stand still, and in most cases become permanently stunted and useless.

Management of Grass Orchards.—The oldest examples of grass orchards are composed of tall standard trees with stems 6 ft. high. The grass is kept short by grazing with sheep, and occasionally even with cattle. Provided that the sheep, during part of the year, receive cake or other concentrated food, the trees are considered to get all the manure they require, though there is no doubt that both the trees and the stock would benefit if such orchards were occasionally dressed with basic slag, steamed bone flour, or some other phosphatic fertiliser. The object in the best-managed orchards is to keep the grass short by grazing, this being particularly desirable during late spring and early summer, when the rapidly-growing herbage makes its heaviest draft on the moisture in the soil.

Pigs and Poultry in Orchards.—Orchards grassed down in recent years are seldom of the tall standard type, but more often contain half-standard trees or bushes on a short leg. Amongst these cattle are out of the question, and even sheep are seldom advisable. The stems of the trees can be protected with wire netting or by painting with a deterrent dressing; but even

then sheep will damage any branches which are within their reach. Many growers, therefore, now run pigs under their trees. Provided that they are regularly fed and watered, and are not kept until too old, pigs very seldom do any damage even to bush-shaped trees. If run thickly enough they keep the grass in check, and supply the trees with all the manure they require, unless it be an occasional dressing of phosphates.

Two methods of pig-keeping are to be seen. One aims merely at keeping the grass under control, the pigs being run over a fairly wide area. The other consists of penning the pigs thickly on a small space at a time, preferably a narrow strip, and moving them on when they have thoroughly worked the ground. This they quickly do so long as the soil is moist enough. In this way the orchard is really kept by the pigs under cultivation, though it may appear somewhat rough at times. The combination of pig-keeping with fruit-growing is being largely taken up, and it is doubtful whether there is any better stock than pigs to run in orchards, both for the benefit of the trees and from a financial point of view. If portable shelters and self-feeders are adopted the labour involved is not considerable.

Some growers prefer poultry in grass orchards. They can hardly be kept thick enough permanently to keep down the grass entirely. In some instances, at any rate, it has been found necessary to mow the herbage once a year and carry it off. This is a drawback, as it means a loss of organic matter. However, the poultry, kept at the rate of about 60 to the acre, are considered to supply the trees with all the manure they require. Poultry have one advantage over other stock in that they destroy a large number of insect pests, though their work in this direction is not sufficient to relieve the grower of the necessity for spraying. Fortunately the birds appear to be unaffected by the poisonous washes used, and need not be moved out of the orchard even when arsenate of lead is employed. Of the classes of poultry available, there is much to be said in favour of the light breeds of ducks, which do not require water for swimming and, if of good strain, are remarkably good egg-layers. One great advantage is that they are easily and cheaply confined by quite low wire netting.

The Sod Mulch System.—What is known in America as the sod mulch system does not appear to have been adopted in this country to any extent. It is considered there as being suitable for districts where the early summer rainfall is not likely to be short, and for land that is too hilly for clean

cultivation. So far as drought resistance is concerned, it occupies a position somewhere between clean cultivation and permanent grass kept down by live stock. The system consists of mowing the grass twice a year and spreading it evenly over the surface, where it forms a mulch for a time, and eventually rots and finds its way into the ground.

The writer has under his management an 8-acre apple orchard which has been under the sod mulch system for six years. It was originally sown with lucerne, the idea being to mow this two or three times a year, and so enrich the soil with organic matter and with nitrogen obtained from the air by the leguminous crop. The lucerne, however, did not last long, probably not caring for the shade of the trees. It has now almost disappeared; but the grass which has taken its place is still mown and left as a mulch. The soil is light and badly in need of organic matter, and for such conditions the sod mulch system seems to be well adapted. This orchard gives a very good account of itself, particularly in a wet season, but during the very severe drought of 1921 it undoubtedly suffered more than the cultivated orchards. Manures, of course, are required; and it may be considered a disadvantage that the bulk of these is used first by the grass, and is not likely to show prompt results on the trees. It must be remembered, however, that, when the grass mulch rots, as it soon does, the manures are returned to the soil in the organic form which seems to be almost essential for fruit trees. This would appear to be an inexpensive way of organic manuring. The comparatively cheap mineral fertilisers can be used entirely, and converted into organic form through the medium of the grass.

The Sod Strip Method.—Although the orchard just mentioned is doing well, one hesitates to do away with cultivation altogether in other orchards, because cultivation is so beneficial during drought, and prompt response can be secured from dressings of organic manures. A compromise is now being tried. The alleys between the rows of trees are ploughed and cultivated as described above under the heading "Clean Cultivation"; but the narrow strips on which the trees actually stand are left under grass, which is mown twice a year and treated as in the sod mulch system. In this way it is hoped to avoid altogether the expense of hand digging and hoeing, and to combine some of the advantages of both grass and cultivated orchards, whilst avoiding their drawbacks. The most active roots must be situated for the most part in the spaces

between the rows, where they receive the advantage of cultivation and manuring. Bulky manures can be ploughed into these strips, which, when cultivated, correspond to the fruit borders of a private garden. The grass strips, it is hoped, will be sufficient to give the well-known grass effect of added colour in the fruit, and possibly also to prevent leaf-scorch. As the system has been in operation for a year only, nothing can yet be said about results; but it is quite a recognised system in Canada, where it is known as the sod strip method, and is found to yield the results outlined above.

Cover Crops.—In most of the countries which send fruit to our markets it is the custom in very many orchards to grow cover crops. It is surprising, therefore, that the plan has apparently not been tried in this country, though a start has recently been made at one of our research stations. It is obvious that the growth of a leguminous crop, such as vetches or clover, which is afterwards ploughed under, is a cheap method of supplying the organic nitrogenous manure which is at once so necessary for fruit-trees and so expensive to buy in ready-made form. Moreover, if the cover crop, when necessary, is given the assistance of phosphatic and potassic fertilisers, these also are returned to the soil in organic form for the use of the trees. So easy is it to supply the necessary nitrogen in this way, that it is found to be quite possible to over-stimulate the trees if a leguminous cover crop is used too often, and a non-leguminous crop, such as rye, has to be substituted when necessary to avoid this.

The usual plan of cultivation, using a cover crop, is to plough the crop under early in spring, and to follow this by surface cultivation at frequent intervals throughout late spring and summer. This is the period when cultivation is of most value to enable the trees to withstand drought. Cultivation continues until some time in early autumn, when the next cover crop is sown. It is considered that the drying effect of the crop is beneficial to the trees in autumn, helping them to ripen their wood. Throughout the winter, of course, it serves to keep the land drier than it would be under clean cultivation, and to prevent the washing out of plant foods.

There may be something about our climate and conditions which would render the use of cover crops less advantageous than it is in other countries; but this needs to be proved by experiment on a considerable scale with different crops.

MARROW-STEM KALE FOR DAIRY COWS.

C. C. MORT.

UNTIL 1916 the writer had relied upon cabbages to provide the bulky succulent food required by cows in the autumn and early winter. About that time he had begun to seek ways of utilising land more continuously than by planting cabbages in May on fields that had been bare since the previous corn harvest, and in 1915-16 rye was grown for spring feeding prior to the planting of the "green" crop. It was on such rye stubble that the first trial was made with marrow-stem kale.*

The kale was sown on 27th May and yielded—as ascertained in November by weighing the produce of a measured plot—24 tons of green forage per acre. The green-stuff was sampled by Mr. J. R. Bond, the County Organiser, and analysed at the Midland College. The figures were as follows, the average analysis of drumhead cabbages as given in "Rations for Live Stock"† being adjoined for comparison:—

		<i>Marrow-stem Kale.</i>		<i>Drumhead Cabbage.</i>	
		<i>Per cent.</i>		<i>Per cent.</i>	
Dry matter	12.8	...	11.0
Protein	1.6	...	1.5
Oil3	...	.4
Soluble carbohydrates	6.4	...	5.9
Fibre	2.8	...	2.0
Ash	1.7	...	1.2

The results of the first trial encouraged the hope that this crop might be substituted for cabbages, which had certain drawbacks—the cost of plants, the labour of planting and hoeing, and the risk of a gappy crop, owing to high mortality at planting or the ravages of the root maggot. A comparative test of the two crops was, however, made in 1917 on land just cleared of early potatoes; one half of the area was planted with cabbage, while the other was sown with marrow-stem kale. The results were decidedly in favour of the latter—it was easier and cheaper to cultivate, gave a heavier yield and appeared to be better food for the cows than cabbage. Since 1917 no cabbages have been grown on this farm.

In 1916 and 1917 the kale crop was cut with an ordinary grass-mower fitted with a reaping flake. The heaps dropped off the machine were loaded on to a cart and led out for consumption on the grass land. In the autumn of 1917, however,

* See "Enterprise in Dairy Farming," J. R. Bond, this *Journal*, August, 1916.

† The Ministry's Misc. Pubn. No. 32, price, 6d., post free.

a better method of utilising the crop was found: the gate between the kale field and the cow pasture was inadvertently left open, with the result that the cows spent the night among the kale. However, no ill effect on the cows followed, so it was decided to continue the grazing of the crop. Since that year the whole of the crop has been grazed off by the cows, and never has any ill effect on them been observed.

The usual period during which the kale crop is required for consumption on this farm is from about the middle of November until the second or third week in December. At this time the cows lie in at night and are out on the kale from about 8 a.m. until 3 p.m. The average daily ration per head in addition to kale was, in 1923, 6 lb. hay, 1 lb. straw chop, 23 lb. brewers' grains, $1\frac{2}{3}$ lb. coconut cake, and $1\frac{2}{3}$ lb. palm nut cake. Cows yielding less than 1 gallon receive no cake, others receive cake at the rate of $2\frac{1}{2}$ lb. per gallon after the first gallon. When particulars of the ration and yields were taken on 12th December last, 18 cows and 10 heifers in milk were producing 72 gallons per day.

Probably many farmers would hesitate to turn a herd of cows into a crop of this nature, naturally fearing that the cattle would take harm, that the crop would be largely wasted by being trodden down and soiled, and that the land would be badly poached. In the writer's seven years' experience of this practice none of these fears has materialised. The cows consume the crop clean and close to the ground, leaving only a stump of about $\frac{1}{2}$ in. long and, although the land in question includes heavy as well as light soils, the damage due to treading has been very small. The kale crop appears to hold the land dry.

After the kale has been consumed, the land is ploughed and as soon as practicable after the middle of January sown with wheat.

Since 1917 the writer has regularly grown marrow-stem kale after early potatoes. The lifting of the earlies usually begins about 25th June, and as soon as a convenient area, say one acre, has been cleared, it is immediately sown with kale. The land requires little preparation—only one stroke with the spring-tine harrow and another with the spiked-chain harrow. The seed is then sown broadcast at the rate of 4 lb. per acre and covered by one stroke with the chain-harrow. As the potato crop has been liberally treated with both dung and artificials, the kale requires no manure, except sometimes a top dressing of nitrate of soda after germination.

On land fairly free from charlock and other annual weeds, kale does not require drilling in rows for horse-hoeing. In 1923, however, the writer grew the crop on land where there was reason to expect weed-troubles, and he drilled the seed in rows 19 in. apart. This distance, however, proved to be unnecessarily wide. It would appear that 9 in. intervals might be ideal, as this spacing would permit of the only hoeing required, viz., that to be given immediately the drill rows are properly visible.

Marrow-stem kale is fairly resistant to finger-and-toe disease, it is capable of withstanding considerable periods of dry weather, and it is not readily injured by frost. Although early sowing is desirable, the writer sowed as late as 25th July in 1920 and obtained a very good yield. Also the date of utilisation is elastic: if the crop is not required until December it may be reserved till then, and even until the beginning of January. In the writer's experience this crop produces a great quantity of valuable green forage with the minimum of expense and labour.

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THE HOME RANGE OF WILD ANIMALS.

H. MORTIMER BATTEN, F.Z.S.

THE distances wild animals travel during the normal course of their lives have recently been much discussed in agricultural circles. Judging from various haphazard statements that have been made, it would seem there is a lack of knowledge on the subject. We may take it that almost without exception a wild animal has an individual home range, with its lair or den or seat roughly as the centre from which it works. It may, of course, have several lairs dotted up and down its main line of travel, in any one of which it rests according to the various circumstances which govern its movements; but nevertheless there is invariably some spot which it regards as home.

The routine of the backwoods trapper serves well to illustrate what is meant by home range. The trapper has his central cache containing his stores, etc., and from this central cache he runs out his trap lines along the various stream banks. At some of the more distant points he builds shelter cabins, at which he can put up should circumstances demand it, but the presence of these outlying cabins does not really affect the over-all extent of his trapping range. If, indeed, the country favours it, he arranges

all his trap lines radiating immediately from his central cache, making each line so short that he is never far enough from home for an extra outlying cabin to be necessary.

It is on exactly the same lines that most wild animals seem to plan their lives. If their food is abundant there is no need to travel far, and no need, therefore, for outlying shelters; but if, on the other hand, their food is scarce, they may have to travel great distances from one source of supply to the next, and outlying shelters are then necessary.

With few exceptions, such as the nomadic weasel tribe, animals do not travel haphazardly, and just as the trapper keeps to the streams, so do wild creatures keep to certain defined lines of their own choosing. Thus the home range represents so many crooked arms radiating from one centre like the branches of a tree. The main arm may run ten or twelve miles, and from it the minor routes branch off to the various feeding quarters of the beasts concerned. When pursued an animal generally runs roughly in a circle, which is the circle of its home range, of the country it knows, and once driven out of that area it is in strange territory, and usually at the mercy of its pursuers.

Having thus explained the chief meaning of home range, we may discuss the range of certain wild animals which are of interest on the farm.

The Hare.—As has been intimated, the distances an animal travels are decided mainly by its food. If its food is abundant its rate of travel is slow, and it probably lives month after month within a mile or two of some central landmark; but if its food is scarce, it travels faster and farther. It therefore follows that it travels greater distances in winter than in summer, and this fact has led to much misunderstanding.

Foxes, hares, and the like have been tracked across the snow for surprising distances during an extremely cold snap, and recently the statement was made that a hare—presumably any hare at any time—will travel thirty miles in a straight line during a single night. I do not doubt that a hare has been tracked that distance, but unquestionably it was a hare that had been starved out by the snow which rendered the record visible. Normally an individual hare may be seen day after day in the same two or three fields, but a starving hare during a period of snow may travel any distance. He, it should be understood, is the exception.

The accompanying sketch shows the home range of a hare I had under observation. This individual possessed a certain

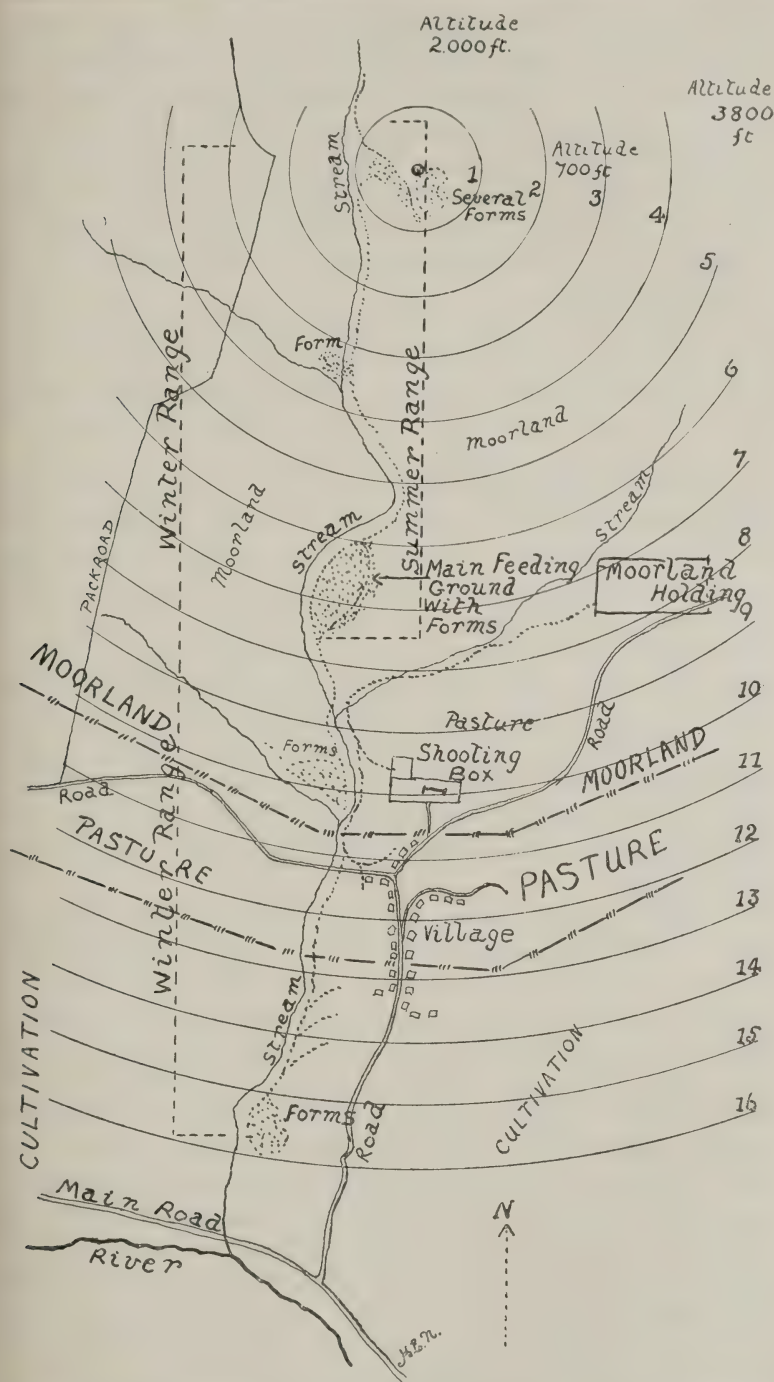


FIG. 1.—The Home Range of a Hare on Southern Slopes. The dotted lines show the Home Range and lines of Travel, and the numbers 1-16 represent miles.

feature by which it was distinguishable, and it lived in a locality where hares were rare. The chart, therefore, is as accurate as several weeks of close study of an individual animal under all weather conditions could make it, and I think it may be taken as representative of the life of the normal hare. There is considerable difference between the summer range and the winter range, and since this animal lived in mountainous surroundings it would travel farther, if anything, than the ordinary brown hare of the valleys.

In dealing with any animal—most certainly in dealing with the hare—we must not endeavour to lay down hard and fast rules. Circumstances adjust their habits. Hares mate during most of the year, only excepting a few weeks in mid-winter, and a mating hare is proverbially erratic.

I do not think, however, that hares cover more ground during their mating activities than normally, as foxes unquestionably do. Hares have certain trysting or meeting places, where they assemble in comparatively great numbers. I have myself repeatedly seen gatherings of fourteen or fifteen hares, and on one occasion counted twenty-seven together. These meeting places are usually waste land, though sometimes the hares meet on rough pasture land, and the hare population, possibly for several miles around, is apt to foregather there at night time.

The Rabbit.—The rabbit is not so great a traveller as the hare, and it is probable that 90 per cent. of the rabbits that live and die spend their lives within two or three miles of the burrow they frequent.

In a hilly country, where pasture lands are the dominant feature, rabbits frequently travel three or four miles during fine nights, returning before sunrise to the point from which they started. In order to understand how stay-at-home a creature the wild rabbit usually is, however, one need only visit a woodland border which a few of them frequent when there is a light tracking snow. It will then be seen that every yard of ground has been traversed by them, and of course this goes on the season through. If it is true of other beasts that they travel no farther than their food requirements demand, it is especially true of the rabbit, and I would say that in ordinary farm country the average rabbit spends his life within a radius of three fields.

The rabbits' home ranges, however, overlap, and while the individual rabbit does not travel far, his trail is crossed and criss-crossed by others of his kind, and their trails in turn are crossed.

The Fox.—The fox after leaving cover does not dally and linger in places where sheep and cattle feed. True, his area of travel is probably close upon twenty miles across—that is, he may travel ten miles out in either direction—but where game is plentiful he rarely leaves the coverts. Normally a fox is in strange territory eleven miles from his home centre, but I have known mountain foxes to hunt pheasants in coverts seventeen miles in a direct line from the Highland cairn where they were nursing their cubs, and to carry their kill that distance home—there being no pheasant coverts nearer. The mountain fox, however, is a child of a lean environment; he travels farther for his food than the little red foxes of the hunting Shires, and he is a hardier, huskier beast.

The fox habitually avoids the open grazing country. He prefers to stalk close under the edge of a woodland or along a ditch bottom, and whenever possible he keeps to the cover, even though it be a hedge, in preference to taking the open. His paws are small, his body is clear of the ground, his stride is comparatively long, but above all he does not loiter.

The Badger.—The badger belongs almost exclusively to the dense woodlands. A badger will make a detour of two or three fields, keeping to the hedge bottom, rather than cross an open gate-gap. Certainly I have known cubs to play about in open pasture, and in the Tweed valley they are not popular owing to their habit of trampling down the crops; but if the badgers come into the open at all, they frequent only one small patch close to their woodland retreat. The badger is the most stay-at-home and secretive animal we have, though old dog badgers are known to live nomadic lives.

The Hedgehog.—Hedgehogs do not travel any great distance. At night time they are fond of frequenting the haunts of cattle in pursuit of the insect life generally abundant there. The hedgehog is a great lover of warmth, and will lie down close under a resting animal—a habit which has no doubt given rise to the common belief that hedgehogs suck cattle. As a rule this hedgehog is liberally infested with vermin, while his long hollow claws form an ideal germ-carrying agency. The animal is an unclean feeder, delighting in carrion, and if one is killed its paws will probably be found to be foul with unclean matter of one kind and another. I have known one to busy itself in an open pasture, turning over the dung of cattle in search of the insect life thus exposed to view.

THE FOOD AND FEEDING HABITS OF THE BLACKBIRD.

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For many years past fruit growers throughout the country have complained of the enormous increase in the number of blackbirds and of the serious damage occasioned by them. On the other hand, many have contended that whatever damage has been done has been more than compensated for by the injurious insects which this species destroys. Unfortunately, we have not hitherto possessed that information respecting the food and feeding habits of the blackbird (*Turdus merula*, Linn.) that would enable the unbiased mind to arrive at any decision as to its economic status.

In the investigation of which the results are here given, the writer has endeavoured:—(i) to compute by the volumetric method the diet of this bird, by an examination of stomach, etc., contents from specimens obtained throughout the country and during each month of the year; (ii) to show the nature and percentage of the food taken in a fruit-growing and an urban district.

Practically every writer on the food of this species has condemned the bird as a malefactor of the worst type, the only one of any note holding a contrary opinion being Yarrell, who regarded the insects, slugs and snails eaten by it, as counterbalancing the amount of fruit destroyed. We must bear in mind, however, that in his day the blackbird was by no means so plentiful as at the present time.

Natural History.—The blackbird commences nest building in March, and eggs have been found in that month, but generally the first brood appears in April, and several broods follow up to July. The number of eggs varies from 4 to 6, 4 or 5 being the more usual. They are of a greenish blue, streaked and spotted with reddish-brown. Incubation takes about fourteen days, and the same period is occupied in fledging the nestling. The nest is built a few feet above the ground in bushes, hedge-rows, etc., rarely in trees. The case is formed of mud and horse-dung, and lined with dried grasses and moss. It is no unusual sight to see the young of this species assisting the parents to feed the later broods.

In addition to the natural increase in the resident population of this species, we have a large autumnal immigration.

Berry has directed attention to the importance of keeping in view a bird's migration habits when considering whether it should be afforded or denied protection, particularly in the breeding season. "This is a difficult question to unravel, but it is at all events clear that it is the individual bird whose services or misdeeds have to be weighed, one against the other, and not necessarily the dietaries of the different birds, or groups of birds, composing the species. If the blackbird or song-thrush that is with us during the breeding season, destroying numberless slugs and snails and noxious insects, leaves us before the autumn fruit ripens, it would be a mistaken policy to destroy that bird in the supposed interests of the apple or pear crop, however much injury may be done to these fruits by immigrant birds of the same species bred in North-western Europe."

Dr. Eagle Clarke† has shown "that a general southward migration, of the British song-thrush at all events, commences as early as the beginning of August, or even in some seasons in July, and the blackbird is seen at the lighthouses by September. Probably many remain till later in the year, and many individuals reside permanently in their native districts. . . . I am inclined to believe that the song-thrush or blackbird who takes a small toll of the strawberries or gooseberries in July is the individual who has been an industrious gardener all summer, but that almost before even the small-fruit season is over, many of the blackbirds and all the song-thrushes have gone from us to be seen no more for good or ill till February comes round; and that the birds seen in autumn—and for the most part in the open fields—are the migrating flocks making their way south from areas far to our north."

"If I am right in this, the indiscriminate slaughter of blackbirds and song-thrushes in the nesting season, under the belief that the fruit crops will thereby be conserved, may do more harm than good to these very crops, and this, even although fruit may form the bulk of the crop-contents of selected individuals, killed for examination in the fruit season. The fruit diet is noticed at once, but the unostentatious consumption of countless hosts of grubs and insects, especially in the early mornings, is much less readily observed."

Whilst fully admitting that this matter of migration is an important one and well worthy of closer attention by the economic ornithologist, our contention is that, in the case of the

* *Scot. Nat.*, 1917, p. 126.

† *Studies in Bird Migration*, Vol. 1, p. 213.

blackbird, both the non-migratory and the immigrant birds are too plentiful, hence the serious damage they have occasioned to fruit crops during recent years.

Field Observations.—Inquiries have been made personally and by correspondence in a large number of districts throughout Great Britain as to the relative abundance of blackbirds. The difficulties of such an inquiry are many, but a general consensus of opinion points to the fact that this species is far too numerous, particularly so in the midland, southern, and south-western counties.

Certain correspondents have assured us that for some years past they have annually destroyed 300 to 1,000 specimens, others have destroyed 100 to 400 eggs, and yet all are agreed that the birds are more numerous to-day than ever before.

In one or two districts we have been able to obtain comparisons with other species: thus we are variously informed that "they (blackbirds) are five or six times as numerous as thrushes"; "there are more blackbirds' nests than any other species excepting the house-sparrow and starling"; "our orchards and gardens are full of them, they are more numerous now than ever before, they will soon be as plentiful as starlings."

These and numerous other similar statements all point to the fact that in spite of the destruction that is carried out in some districts, the blackbird is far too plentiful, and that it is increasing.

Food Habits.—As the result of an examination of the stomach contents of 285 specimens we found that 39 per cent. of the total food consumed during the year is of an animal nature and 61 per cent. vegetable. The animal food may be subdivided as follows:—22 per cent. of injurious insects, 3.5 per cent. of beneficial insects, and 5.5 per cent. of neutral insects, 4 per cent. earthworms, 2.5 per cent. slugs and snails, and 1.5 per cent. miscellaneous animal matter.

Amongst the injurious insects we find wireworms, the larvæ and beetles of the clay-coloured weevil (*Otiorrhynchus picipes*, Fabr.), larvæ of various *Noctuae*, leather jackets and various dipterous larvæ.

The vegetable food consists of 25.5 per cent. cultivated fruits (strawberry, raspberry, gooseberry, currant, and apple, pear, and plum as fruit pulp), 2.5 per cent. wheat, 2.5 per cent. roots, 24.5 per cent. wild fruits and seeds, and 6 per cent. miscellaneous vegetable matter.

A summary of these different items shows that of the total food consumed the blackbird is beneficial as regards 24.5 per cent., neutral as to 41.5 per cent., and injurious as to 34 per cent.

In investigations on the food and feeding habits of the house-sparrow and the starling the writer has shown the differences that occur in the percentages of the various food items in different districts, and these have been computed for the present species also.

Food of blackbirds in Fruit-growing and Urban Districts.

<i>Food Items.</i>			<i>Five Fruit Growing Districts.</i>	<i>Five Urban Districts.</i>	<i>Average for whole of country.</i>
<i>Animal food.</i>					
Injurious Insects	...	...	16.5	23.0	22.0
Beneficial Insects	...	...	3.0	3.0	3.5
Neutral Insects	...	...	4.0	3.5	5.5
Earthworms	...	...	3.0	4.5	4.0
Slugs and Snails	...	...	3.0	3.5	2.5
Misc. animal matter	...	...	2.5	4.0	1.5
Household refuse	...	...	—	3.0	—
Totals	...	...	32.0	45.5	39.0
<i>Vegetable food.</i>					
Cultivated fruits and fruit pulp			28.5	18.5	25.5
Wheat	...	...	2.0	1.0	2.5
Roots	...	...	1.0	1.5	2.5
Wild Fruits and Seeds	...	...	32.0	26.0	24.5
Misc. vegetable matter	...	...	4.5	7.5	6.0
Totals	...	...	68.0	54.5	61.0

In fruit-growing districts, therefore, the percentage of cultivated fruits and fruit pulp is much larger than the mean average. This destruction of fruit commences as soon as it begins to ripen and continues until it is gathered. It is clear that it is much easier to obtain than any other kind of food at a certain season of the year, and during that period the percentage of animal and other food taken is at its lowest. Again, for the remainder of the year the most abundant supply of food consists of wild fruits and seeds; indeed, it may be said that it is practically only during the late winter and spring that any considerable amount of animal food is consumed.

The figures for urban districts show a decrease of 10 per cent. in the amount of cultivated fruits consumed, of 7 per cent. under the mean average, and a decrease of 6 per cent. in the

quantity of wild fruits and seeds, or 1.5 per cent. above the mean average. In such districts cultivated fruits are not so plentiful, and hence a lower percentage is consumed, or we may say that there is an abundance of food generally which is more easily obtained. This is borne out by a reference to the nature of the animal food consumed. The injurious insects show an increase of 6.5 per cent. over the fruit-growing districts, and 1 per cent. over the mean average. Taking the total bulk of insect food (injurious, beneficial and neutral) there is a decrease of 1.5 per cent. on the mean average. To summarise, we may state that in fruit-growing districts the consumption of animal food is at its lowest, being 13.5 per cent. below that of the urban districts and 7 per cent. below that of the average mean, whereas the consumption of vegetable matter in fruit-growing districts is 13.5 per cent. above that of the urban districts and 7 per cent. above that of the average mean.

Investigations conducted in this and other countries on different species of wild birds suggest that this is precisely what we should expect. Over and over again it has been pointed out that a bird feeds upon the food that is the most easily obtained, and that the reason why a species becomes injurious is that we have too many of that species feeding upon the same kind of food.

It does not seem necessary to enter into any further analysis of the figures obtained. for it is doubtless patent to every unprejudiced mind that at the present time we have too large a resident population of blackbirds—which is from time to time augmented by immigrants. The struggle for existence must be very keen, and so long as these conditions obtain in fruit-growing districts, the blackbird will continue to be one of the most destructive birds with which the fruit-grower has to contend. Before it can be regarded as a neutral or a beneficial factor its numbers will have to undergo considerable diminution.

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MAY ON THE FARM.

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Weather Notes.—There is a natural tendency to hail May as a summer month; the days are long, there is usually a good duration of bright sunshine and there may be some hot days; buds open and flowers bloom; and both bird and insect life become manifestly active. This month, however, properly belongs

to the spring quarter; its mean temperature, normally 51° F. in the Midlands, is $5\frac{1}{2}^{\circ}$ F. warmer than April but $5\frac{3}{4}^{\circ}$ F. colder than June, and the nights are frequently chilly. Occasionally there is snow in May; on the average there are ground frosts on three to five mornings; while on the eastern side of the country cold east winds often prevail during the first half of the month. The rainfall is normally rather low and the rate of evaporation high, so that the complete destruction of "twitch" by drying is now usually possible. Up to the date of writing, however, the spring has been abnormally cold and dry, and all outdoor vegetation is backward; farmers are, therefore, looking forward with unusual interest to the advent of the fifth month.

Grass Day.—In the Midland counties cows usually begin to lie out in the pastures about the 12th of the month, "Old May Day," or in farming terminology "Grass Day." The actual date for the change from winter to summer management of cattle varies, however, according to circumstances—the class of stock, the forwardness of the grass, the weather, and the remaining supplies of fodder and roots. In this matter there is considerable difference of opinion among farmers, some contending that the pastures should be broken early, before the grass has risen to a full bite, others maintaining that too early grazing unduly exposes the sward to the effects of drought later in the season.

In favour of early grazing, it may be said that it tends to a more even consumption of the entire herbage; whereas, when there is a full bite at turning out time, the stock are apt to select the best patches, leaving the coarser herbage to run to seed. Young pastures and rotation grasses should certainly be eaten down fairly soon; and when fields are known to "eat off" badly cattle should be turned into them before they have tasted better herbage. Another argument in favour of early grazing is that it encourages the grasses to tiller and form a close sward, and it favours the clovers, which are apt to be repressed by a long growth above them.

Another series of considerations arises with regard to the class and condition of the stock to be grazed. With dry stock—strong stores and dry cows—a full bite is not necessary, and some deficiency of grass may be an advantage, in that it ensures a more gradual transition from dry winter-keep to succulent spring herbage. Such cattle are, therefore, often turned out early in April. Some thought must, however, be given to the avoidance of chills; cattle that have been managed in a manner that has

preserved their natural winter coat may lie out earlier than such as have been warmly housed and well fed all the winter.

With regard to dairy cows, especially those recently calved, it seems to be generally agreed among the best farmers that grazing should not begin until the grass affords a full bite of "mature" herbage. It is often said that the herd should not lie out until apple trees are in bloom. Cows in full milk require a liberal supply of nutriment to maintain the flow and keep up body condition; but it is difficult at this time of the year to correct deficiencies in quality or quantity of the grazing by the use of fodder or concentrates, as after tasting grass the cattle will not eat much dry food.

It is a point of good management to prepare the cows for the change from winter to summer rations and conditions. They are best protected against chills when the sheds have been kept cool and well ventilated all the winter, failing which, hardening off should begin in good time before grass-day. The change of diet is less drastic where the root supply has been so husbanded that the ration has been more succulent than usual during the latter part of April. One very good dairy farmer known to the writer endeavours to reserve a month's supply of mangolds for use after May Day. Another good practice is that of mixing green fodder—rye or rye grass specially top dressed for the purpose—with the hay and straw chaff fed during the last fortnight before turning out time.

Cow Cabbage.—On heavy soils and in dry, warm districts, dairy farmers replace the turnip crop with cabbages and mangolds. It is not practicable to sow the whole of the root break with mangolds—some portions may require more spring working than is conducive to good results with that crop; and in any case mangold roots do not reach a satisfactory stage of ripeness for feeding until about the end of the year. From the time when grass ceases to grow—about the end of October according to the season and district—and until about the New Year, cow cabbages may provide suitable green food.

Under favourable circumstances—moist land in rich condition and a moderately warm and sunny season—yields of 50 or more tons of heads per acre are obtainable without irrigation, while crops weighing 25 to 30 tons per acre are typically fair results of ordinary good farming. For high yields, however, it is important to secure plants of a good strain; in one of the writer's experiments the difference in yield due to strain amounted to 15 tons per acre, while that due to fertilisers was 10 tons.

The best plants are produced by small market gardeners who obtain their stock-seed by personal selection. In autumn they go through fields planted with seedlings of their strain and select a dray load of the largest, firmest and best shaped heads; which they afterwards set out for seed production. This practice, pursued for many years, has resulted in the development of local strains of high productivity. One important respect in which they excel ordinary drumheads is their ability to keep firm in the heart until Christmas time, whereas the latter often heart and burst too soon for dairying conditions. The plant grower sows the cabbage seed in August, and about October transplants the seedlings into rows or beds, from which they are drawn for sale in May.

Cow cabbages resemble mangolds in their soil and manurial requirements—firm rooting ground, moisture, and liberal supplies of nitrogen. Flat cultivation has the advantage of permitting the horse hoe to be used in two directions, the land being first “scrawled” out lengthways and crossways (or diagonally) and the plants being set in the points where the marks intersect. On heavy land, however, it is usually better to grow the crop on ridges, owing to the fact that the crop has to be harvested in November and December.

At planting time the soil should be firm and moist: loose, cloddy ridges do not afford proper rooting conditions. Where the tilth is rather harsh and dry—and strong land usually is in that stage after spring cleaning operations—the ridges should be ridge-rolled and allowed to lie a week or two before planting. The soil should be firm enough to require the use of a spade rather than a dibble for planting. An ordinary spacing for the plants on good land is 30 in. each way, for which 7,000 plants are required for one acre: when spaced 24 in. apart in 27 in. drills, as on less productive soils, about 10,000 plants are required per acre.

In cool seasons late cow cabbages may fail to heart satisfactorily, as was not uncommon in 1923: in dry sunny years, however, a more serious trouble may be encountered—the root maggot. From actual experimental trial the writer can vouch for the effectiveness of “dises” put round the stem of the plants at planting time;* but this method is hardly so convenient to adopt as that of sowing pungent substances—such as powders containing creosote or naphthalene or even soot—round the plants.

* See the Ministry's Leaflet No. 122.

MANURES FOR MAY.

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Manures for Swedes.—The manurial treatment for this crop depends on two main factors, the lime supply of the soil, and the climatic conditions. If the soil is sour trouble will almost certainly arise through the disease known as finger-and-toe, and treatment must be directed towards correcting acidity as much as towards feeding the crop. The soundest remedy for finger-and-toe is to lime or chalk the land, but if this cannot be undertaken a partial but less satisfactory remedy is to substitute nitrate of soda or nitrate of lime for sulphate of ammonia, and basic slag for superphosphate. It is doubtful if the latter course is of much value if the soil is distinctly acid, but it does postpone the setting up of sour conditions, and this is of importance in the case of fields containing a very small amount of lime.

The climatic conditions largely determine how big a crop of swedes can be grown. In most areas a yield of 25-30 tons per acre is not unusual, while in the drier and hotter districts of the south only about half that yield is obtained. The scale of manuring should therefore be adapted to the size of the average crop. The most important constituent in the manure for swedes is phosphate, and superphosphate is the form which is most commonly chosen, on account of its quick-acting properties. A supply of phosphate helps the young plant to make a good start and brings it early to the hoe; it also improves the feeding value of the roots. Swedes can be grown without dung on cool soils and in moist areas, but in droughty districts short dung is of great value for its water-holding properties. If no dung is used and fair crops are possible, potash should be included in the mixture in all but the stiff soils, and care must be taken not to limit the crop by lack of nitrogen.

The following dressings per acre, modified as suggested above for soils short in lime, have been found suitable under the conditions stated:—

(a)	(b)	(c)	(d)
<i>Thin sheep downs.</i>	<i>Dry districts.</i>	<i>Moist areas, with dung.</i>	<i>No dung available.</i>
3 cwt. superphosphate.	10 tons dung, 3 cwt. superphosphate.	10 tons dung, 4 cwt. superphosphate, 1 cwt. sulphate of ammonia.	5 cwt. superphosphate, 1 cwt. sulphate of ammonia, 1 cwt. muriate of potash.

All these manures should be applied before sowing. In the case of (d) 1 cwt. of nitrate of soda may be given as a top dressing after singling if thought necessary.

Potash for Grassland.—The inclusion of potash in the manures for hay land is now fairly general on all but the stiffer soils, and experience often shows that even heavy land cannot stand the drain of potash which continuous mowing involves.

The value of potash manures for the improvement of grazing land, particularly on the lighter soils, is also becoming recognised. The first year's results of a manuring-for-milk experiment commenced in 1923 at the Staffordshire Farm Institute have recently been published. A poor light-land meadow which only yielded about 12 cwt. of hay per acre was devoted to the experiment. It was limed at the rate of 2 tons per acre and fenced off into three plots each of $3\frac{1}{2}$ acres, which were grazed by dairy cows for 18 weeks, the milk being weighed. The figures for 1923, which are preliminary in nature, are given below:—

<i>Treatment per acre.</i>	<i>Milk, gal. per acre.</i>
No manure.	264
4 cwt. superphosphate.	261
Do. + 1 cwt. sulphate of potash.	322

At present prices the increase obtained by the use of the mixture of phosphate and potash is amply remunerative. The results were in agreement with observations made in the field, where it was noted that phosphate alone had little effect, but the combination of phosphate and potash gave a vigorous leguminous herbage. Although sulphate of potash was used in this particular case similar results could be looked for from the application of the same amount of potash in the form of muriate of potash, or the lower grade of potash manures.

Storage of Dung.—It sometimes happens that dung made in spring cannot be carted out and applied for the current season's crops. In such cases it must be stored till the autumn. Summer storage involves bigger losses of nitrogen and dry matter by fermentation than occur in winter, and although these losses cannot be prevented they can in some degree be controlled by good management. If the dung has been made in covered yards or boxes its manurial value is best preserved by leaving it undisturbed, but if it lies in open yards or exposed heaps it should be made into as tight a clamp as possible and a covering of earth provided. A disadvantage of summer storage, particularly if the heap is kept under cover, is that the manure may become too dry. This retards the rotting of the straw, and the nitrates which are produced under dry conditions are liable to decompose if the heap is subsequently wetted.

Experiment has shown that less loss of fertilising constituents occurs under cover than in the open, and to keep the manure moist it is preferable to conserve as much as possible of the liquid originally present by keeping the dung compact, rather than to pump water or liquid manure over the heap.

Cabbages.—Autumn-planted cabbages intended for summer use may have their final dressing of about 1 cwt. per acre of nitrate of soda or sulphate of ammonia at this time of the year if they appear to require a little help. Cabbages drilled or planted in spring will respond to a complete artificial fertiliser in addition to dung, and if farmyard manure is not available a generous supply of artificials will be needed to grow good crops. Nitrogen is the main requirement on most classes of land, but nitrogenous manuring unbalanced by phosphate and potash tends to give an open habit of growth very undesirable in cabbages. On stiff land the need of phosphates is greater than of potash; on lighter soils both are necessary. Suitable dressings per acre for medium land would be :—

(a) <i>With dung.</i>		(b) <i>Without dung.</i>	
4 cwt. superphosphate.	} Before drilling or planting.	6 cwt. superphosphate.	} Before drilling or planting.
$\frac{1}{2}$ „ muriate of potash.		1-2 cwt. sulphate of ammonia.	
2 „ nitrate of soda.		1 cwt. muriate of potash. 2 cwt. nitrate of soda.	

The nitrate of soda would be given in two top dressings during the growing season and in the case of widely spaced varieties it is preferable to apply it by hand near the stems of the plant rather than broadcast over the whole area. Salts such as kainit, sylvinit or potash salts are quite as suitable for cabbages as muriate of potash, for the common salt introduced with such substances benefits the crop. Similar manurial treatment may be given to Brussels sprouts and broccoli, and in intensive culture the above dressings of nitrate of soda are often considerably increased. No nitrate of soda would be applied late in the season to crops which have to stand the winter, it being more profitably reserved till growth commences in the spring.

Manurial Residues.—The bulk of the fertilisers for the season's crops will now have been applied, and it is of interest to consider what residues can be expected from these dressings for the use of future crops. There are two main sources of information on this point: (1) the evidence derived from the chemical behaviour of manures in the soil, and in particular from the analysis of drainage water from soils manured in different ways; and (2) the results of field experiments where the residues are measured by the crops which they produce.

Nitrogenous Manures.—The soil has no power to retain nitrates; hence nitrogen supplied in the form of nitrates of soda or of lime leaves no direct residue. The same applies to the nitrogen of sulphate of ammonia, dried blood and rape cake, which is speedily converted into nitrate in the soil. If the bigger crops of roots and straw grown by the use of such manures are fed on the farm the dung heap receives indirect benefit in this way, but only a small part of the nitrogen in the manure is thus restored to the soil. If, for example, by the use of 1 cwt. per acre of sulphate of ammonia the oat crop is increased by 7 bushels per acre and a proportionate amount of straw, the quantity of nitrogen recovered in the increased produce would be about 9 lb. If both corn and straw are fed we can expect that about half of this nitrogen will find its way back to the land through the dung, hence of the 23 lb. of nitrogen provided by 1 cwt. of sulphate of ammonia, $4\frac{1}{2}$ lb. or 20 per cent. returns to the land. The above case, however, is a favourable one because all the produce is fed on the holding; if the grain was sold the restoration of nitrogen would fall to about 6 per cent.

A large proportion of the nitrogen of fish meal, meat meal, and guano is quickly nitrified and therefore yields no direct residue; any more resistant balance will come in for the following crop. The nitrogen of shoddy is slower in its action, and its effects, although greatest in the first year, have been traced through three successive crops at Rothamsted.

Phosphates and Potash.—Investigations on the behaviour of these substances when applied to the soil show that phosphates, even if applied in a water-soluble condition, are almost wholly retained in the surface soil. and that even after many years a large proportion of this retained phosphate exists in a citric-soluble form. Potash manures, although largely retained, travel faster into the subsoil and bulk rather more largely in the drainage than do the phosphates. The most serious drain on both phosphates and potash is that caused by the growing crop. The approximate amounts of these constituents removed from the soil by the crops of a five-course rotation are given below. Quantities of phosphoric acid and potash may be converted into their equivalents of 30 per cent. superphosphate or 50 per cent. muriate of potash by multiplying by the factors 7.2 or 2.0 respectively.

Year.	Crop.	Yield per acre.	Removed in Crop.		Disposal of Crop.
			Phos. acre.	Pot.	
1st	Mangolds 1/3 ac.	22 tons roots	lb. 12.1	lb. 74.3	roots fed.
	Potatoes " }	6 " tubers	7.2	25.5	sold.
	Swedes " }	14 " roots	5.6	21.1	roots fed.
	1 acre.				
2nd	Barley, 1 ac. grain	40 bus.	16.0	9.8	sold.
	" " straw	24 cwt.	4.7	25.9	to dung.
3rd	Clover, 1 acre	2 tons	24.9	83.4	fed.
4th	Wheat, 1 ac. grain	30 bus.	14.2	9.3	sold.
	" " straw	25 cwt.	6.9	19.5	to dung.
5th	Oats, 1 ac. grain	45 bus.	13.0	9.1	fed.
	" " straw	25 cwt.	6.4	37.0	fed.

The loss of phosphate and potash from 1 acre during a complete rotation will be the amounts of these constituents contained in the crops sold off together with about one-quarter of that contained in the crops fed, this being the usual estimate of the loss of phosphate and potash which occurs in making dung. The loss of phosphate by drainage is negligible, but there will usually be a very small loss of potash in this way. From the above figures we obtain:—

Loss of phosphate and potash (lb. per acre) during a 5-course rotation.

	Phosphoric acid.	Potash.
Removed by crops sold off	37.4	44.6
Lost in making dung	15.5	56.2
Total loss during 5 years	52.9	100.8

Hence under the above system the loss to 1 acre of soil due to cropping will be 53 lb. of phosphoric acid and 100 lb. of potash, equivalent to about $2\frac{1}{2}$ cwt. of 30 per cent. superphosphate and 2 cwt. of muriate of potash per rotation. Under ordinary conditions the quantity of superphosphate will often exceed $2\frac{1}{2}$ cwt. per rotation, for 4 cwt. might well be given to roots and a further 2 cwt. to the second corn crop. The quantity of potash will rarely exceed the 2 cwt. per acre per rotation required to maintain the soil; 1 cwt. would probably go to the roots and a further $\frac{1}{2}$ cwt. might be given to the clover or oats on light soil, but it is seldom that more potash than this would be used. Any purchased foods consumed on the holding would enrich the dung to the extent of their manurial value and improve the phosphate and potash balance to that extent.

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	Average Price per ton during week ending April 2nd.				Cost per Unit at London
	Bristol	Hull	L'pool	L'ndn	
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 5	14. 0	13.12	13.17	17.11
" " Lime (N. 13 per cent.) ... ..	...	12.10	...	12.10	19. 3
Sulphate of Ammonia, ordinary (A. 25¼ per cent.)	14. 2*	14. 2*	14. 2*	14. 2*	(N)13. 7
" " " neutral (A. 25¾ per cent.)	15. 5*	15. 5*	15. 5*	15. 5*	(N)14. 5
Kainit (Pot. 12½ per cent.) ... ..	...	...	...	2. 5	3. 7
French Kainit (Pot. 14 per cent.)	2.10	2. 6	2. 5	2.12	3. 9
" " (Pot. 20 per cent.) ... ..	...	...	...	2.17	2.10
Potash Salts (Pot. 30 per cent.) ... ..	...	...	...	3.15	2. 6
" " (Pot. 20 per cent.) ... ..	...	...	...	2.12	2. 7
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7. 5	7.10	7. 7	2.11
Sulphate of Potash (Pot. 48 per cent.) ...	...	11. 5	11.10	11.10	4. 9
Basic Slag (T.P. 28 per cent.) ... ..	...	2. 4§	...	...	...
" " (T.P. 26 per cent.)	2.13§	2. 0§	...	...	...
" " (T.P. 24 per cent.)	2. 9§	1.16§	2. 0§	...	...
" " (T.P. 18 per cent.)	2. 3§	...	1.15§	...	...
Superphosphate (S.P. 35 per cent.) ...	4. 4	...	3.15§	3.15	2. 2
" " (S.P. 30 per cent.)	3.16	3. 7	3. 8§	3. 7	2. 3
Bone Meal (A. 4½. T.P. 45 per cent.) ...	9.10	8.15	8.17	8. 5	...
Steamed Bone Flour (A. 1. T.P. 60 per cent.)	6.10	6.17†	6. 5	6.12†	...
Fish Guano (A. 9-10. T.P. 16-20 per cent.)...	12.15	...	12.10	...	...
" " (A. 11, T.P. 10 per cent.) ... ..	...	...	...	13.10	...

Abbreviations: N.=Nitrogen; A.=Ammonia; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire; London prices include delivery within a limited area. Cost to purchasers in other districts will be greater or less according to the distance of different purchasers from the works.

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MONTHLY NOTES ON FEEDING STUFFS.

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The Evaluation of Feeding Stuffs and its Relation to Recent Research.—Comparatively recent developments in research in animal nutrition have emphasised the importance of including in rations for farm animals adequate quantities of mineral salts, and other substances of unknown chemical composition labelled for convenience “vitamins.”

Mineral Substances in Rations.—It has been clearly established that the inclusion of certain mineral substances is essential to the growth and well-being of an animal. Normally such substances are contained in adequate amounts in the ration fed to the animal. Owing, however, to the fact that certain foods are deficient in one or more of these mineral elements, a ration is occasionally met with which is deficient in these elements. In such a case, the actual addition of mineral substances to the ration has been shown to be followed by beneficial results and to be economically a sound policy. In the case of animals yielding milk in large quantity, such as a 2,000 gallon cow, it may also be necessary to add mineral substances to the ration to allow for the drain on the organism caused by the heavy yield of milk. The elements that experience has found to be normally deficient in certain dietaries are Calcium, Phosphorus, Chlorine and Sodium. Recent research has also indicated that under certain conditions Iron may be deficient to such an extent that severe metabolic disturbances may arise.

Cheap and convenient sources of supply of the above elements are to be found in chalk, common salt, steamed bone flour, and precipitated phosphate. It must be remembered that excess of Phosphorus is normally excreted from the body in the form of calcium phosphate, and it is therefore desirable to supply any calcium deficiency in a dietary in the form of chalk rather than bone phosphate.

Vitamins.—The story of vitamins has been given sufficient publicity elsewhere to render its repetition unnecessary here. Briefly stated, it has been found that certain substances called “vitamins” are essential to growth and healthy development, and their absence in dietaries causes malnutrition and severe

DESCRIPTION.	Price per Qr.		Price per		Manurial Value per Ton.	Cost of Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv.	Price per lb. Starch Equiv.
			Cwt.	Ton.					
	s. d.	lb.	s. d.	£ s.	£ s.	£ s.	s.	d.	
Wheat, British - -	—	—	10/11	10 18	0 16	10 2	71·6	2/10	1·52
Barley, British Feeding	—	—	10/9	10 15	0 12	10 3	71	2/10	1·52
" Canadian No. 4	—	—	—	—	—	—	—	—	—
Western	34/6	400	9/8	9 13	0 12	9 1	71	2/7	1·47
" Tunisian	33/6	—	9/5	9 8	0 12	8 16	71	2/6	1·34
" Karachi	33/3	—	9/4	9 7	0 12	8 15	71	2/6	1·34
Oats, English, White -	—	—	10/4	10 7	0 14	9 13	59·5	3/3	1·74
" " Black and	—	—	—	—	—	—	—	—	—
Grey	—	—	9/8	9 13	0 14	8 19	59·5	3/-	1·61
" Canadian No. 2	—	—	—	—	—	—	—	—	—
Western	26/9	320	9/4	9 7	0 14	8 13	59·5	2/11	1·56
" " No. 3	25/9	—	9/0	9 0	0 14	8 6	59·5	2/9	1·47
" Canadian Feed -	24/6	—	8/7	8 12	0 14	7 18	59·5	2/8	1·47
" Argentine -	22/6	—	7/10	7 17	0 14	7 3	59·5	2/5	1·29
" Chilian -	24/6	—	8/7	8 12†	0 14	7 18	59·5	2/8	1·43
Maize, American -	42/6	480	9/11	9 18†	0 13	9 5	81	2/3	1·20
" Argentine -	43/9	—	10/2	10 3	0 13	9 10	81	2/4	1·25
Beans, Rangoon -	—	—	11/4	11 7†	1 13	9 14	67	2/11	1·56
Peas, Japanese -	—	—	22/3	22 5†	1 9	20 16	69	6/-	3·21
Millers' Offals:—	—	—	—	—	—	—	—	—	—
Bran, British -	—	—	—	7 7	1 7	6 0	45	2/8	1·43
Broad -	—	—	—	8 5	1 7	6 18	45	3/1	1·65
Middlings Fine (Im-	—	—	—	—	—	—	—	—	—
ported)	—	—	—	7 9	1 3	8 4	72	2/3	1·20
" Coarse (British)	—	—	—	7 17	1 3	6 14	64	2/1	1·12
Pollards, Imported	—	—	—	7 5	1 7	5 18	60	2/-	1·07
Meal, Barley -	—	—	—	10 10	0 12	9 18	71	2/9	1·47
" Maize -	—	—	—	11 15	0 13	11 2	81	2/9	1·47
" " Germ -	—	—	—	9 12	0 19	8 13	85·3	2/-	1·07
" " Gluten-feed	—	—	—	9 7	1 8	7 19	75·6	2/1	1·12
" Locust Bean	—	—	—	8 5	0 10	7 15	71·4	2/2	1·16
" Bean -	—	—	—	13 0	1 13	11 7	67	3/5	1·83
" Fish -	—	—	—	20 0	4 8	15 12	53	5/11	3·17
Linseed -	—	—	—	20 5	1 12	18 13	119	3/2	1·70
" Cake, English	—	—	—	—	—	—	—	—	—
12% Oil	—	—	—	13 0	1 19	11 1	74	3/-	1·61
" 10% Oil	—	—	—	12 0	1 19	10 1	74	2/9	1·47
" 9% Oil	—	—	—	11 17	1 19	9 18	74	2/8	1·43
Cottonseed Cake, English	—	—	—	—	—	—	—	—	—
5½% Oil	—	—	—	7 15	1 16	5 19	42	2/10	1·52
" " Egyptian	—	—	—	—	—	—	—	—	—
5½% Oil	—	—	—	7 12	1 16	5 16	42	2/9	1·47
Decorticated Cotton	—	—	—	—	—	—	—	—	—
Seed Meal 7% Oil -	—	—	—	13 5†	2 16	10 9	71	2/11	1·56
Coconut Cake 6% Oil -	—	—	—	9 15	1 11	8 4	73	2/3	1·20
Palm Kernel Cake 6% Oil	—	—	—	7 15†	1 5	6 10	71·3	1/10	0·98
Feeding Treacle -	—	—	—	6 15	0 8	6 7	51	2/6	1·34
Brewers' Grains:—	—	—	—	—	—	—	—	—	—
Dried Ale -	—	—	—	8 0	1 5	6 15	49	2/9	1·47
" Porter -	—	—	—	7 10	1 5	6 5	49	2/7	1·38
Wet Ale -	—	—	—	1 15	0 9	1 6	15	1/9	0·94
" Porter -	—	—	—	1 10	0 9	1 1	15	1/5	0·76
Malt Culms -	—	—	—	8 0	1 15	6 5	43	2/11	1·56

† At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of March and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose coconut cake is offered locally at £10 per ton. Its manurial value is £1 11s. per ton. The food value per ton is therefore £8 9s. per ton. Dividing this figure by 73, the starch equivalent of coconut cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 13s. 6d.; P₂O₅, 4s. 1d.; K₂O, 2s. 6d.

metabolic disturbance. Other facts have also been demonstrated: (1) that it is difficult to obtain foods absolutely free from vitamins, and (2) that animals vary in their reaction to the absence or presence of these vitamins. Moreover, it has been shown that under ordinary farming conditions, the usual mixed ration given to animals contains the necessary vitamins in adequate amounts, and there is generally no need to make special provision for the supply of vitamins.

How do the above facts affect our methods of evaluating feeding stuffs? From the purchasing standpoint the value of a feeding stuff depends upon its nutritive value and its manurial value. The nutritive value has hitherto been based upon its starch equivalent or fattening capacity. Should the mineral constituents or the vitamin content be taken into consideration in assessing the nutritive value? The answer is, No, under ordinary circumstances, (1) for the simple reason that the value of the mineral or the vitamin in a feeding stuff depends entirely upon the nature of the ration with which it is fed, and (2) because there is reason to assume that after the basal requirement of the organism for vitamin or mineral is satisfied any further mineral or vitamin added is of little or no value.

FARM VALUES.

CROPS.	Market Value per lb. S.E.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton.		Manurial Value per Ton.		Value per Ton on Farm.	
				£	s.	£	s.	£	s.
Wheat - - - - -	1·20	2 3	71·6	8	1	0 16		8	17
Oats - - - - -	1·20	2 3	59·5	6	14	0 14		7	8
Barley - - - - -	1·20	2 3	71·0	8	0	0 12		8	12
Potatoes - - - - -	1·20	2 3	18·0	2	1	0 4		2	5
Swedes - - - - -	1·20	2 3	7·0	0	16	0 2		0	18
Mangolds - - - - -	1·20	2 3	6·0	0	14	0 3		0	17
Good Meadow Hay - -	1·47	2 9	31·0	4	5	0 14		4	19
Good Oat Straw - - -	1·47	2 9	17·0	2	7	0 7		2	14
Good Clover Hay - - -	1·47	2 9	32·0	4	8	1 1		5	9
Vetch and Oat Silage - -	1·34	2 6	14·0	1	15	0 7		2	2

* * * * *

In the House of Commons on 26th February last Lady TERRINGTON asked the Minister of Agriculture whether he is aware of the traffic in worn-out horses; how many have been exported from this country during the last six months; and what steps he is taking to prevent this traffic?

The Rt. Hon. NOEL BUXTON, Minister of Agriculture, replied: "I should explain that there is no traffic in

worn-out horses because the Ministry insists on a very high standard of fitness in all horses for export, and no horse is passed for shipment unless it is in every sense fit to travel and to work. I intend to do everything in my power to maintain in full vigour the stringent regulations which have been in force during the past three years, and have effectively removed any undesirable features from this trade 10,918 horses were shipped from Great Britain to the Continent during the six months from August, 1923, to January, 1924. A considerable number of the animals are of high value, but owing to the high price of other meat on the Continent, horse fleshers are able to pay high prices for quite good class horses to be slaughtered for human food. I have no power to prevent butchers purchasing such horses after their arrival on the Continent, but, so far as I can ascertain, many of these horses are slaughtered in public abattoirs by humane methods. The last part of the question does not therefore arise."

* * * * *

THE Ministry attaches great importance to the question of the testing of varieties of farm crops—work which, if skilfully and systematically carried out, will afford information as to the qualities of any particular crop and its suitability for different soils or climatic conditions.

Testing Varieties of Farm Crops.

In the past British farmers have had, apart from actual trial, no certain means of recognising real improvements (particularly for their own farms) among the crowd of fresh introductions; and it has become essential, if waste and disappointment are to be avoided, that every new introduction should be vouched for by trustworthy tests extending over several years in a variety of soils and climates. The benefits which may be expected from well-planned trials are indicated by the results obtained in Denmark and by the remarkable improvements in the yields and quality of Irish barley during the last twenty years consequent upon a comprehensive system of trials begun in 1901.

Such work was among the objects for which the National Institute of Agricultural Botany was established. Carried out hitherto on a limited scale, the work of this Institute is now to be considerably extended through the action of the Ministry, which is making arrangements for some half-dozen stations to be established in typical arable areas which will all work to a common scheme formulated by the Institute.

HITHERTO the Ministry has accorded somewhat different treatment to research in agricultural engineering from that given to research in all other subjects of an agricultural nature. It will be recalled that in its administration of agricultural research in general, the Ministry has arranged for research in separate subjects related to agriculture. *e.g.*, horticulture, plant breeding, etc., to be dealt with at one or more Research Institutes specially established for the purpose, which are either departments of Universities or independently governed bodies. Thus research in horticulture is dealt with at the Long Ashton Station which is administered by Bristol University, at the East Malling Station which is administered by a separately incorporated governing body, and at the Horticultural Research Station at Cambridge which is administered by Cambridge University. Rothamsted Experimental Station, which undertakes research into the two subjects of plant nutrition and plant disease, is an example of an independently governed station.

The Ministry has, however, for some years now been directly responsible for investigations in agricultural machinery. There were at the inception of research into this subject special reasons for singling out agricultural engineering for different treatment from that obtaining in other branches of agricultural science. The subject was quite new to this country. There was no University or other Institution which had devoted attention to the subject, while on the other hand, the Ministry had accumulated a great deal of knowledge and experience in it during the war and had in its service a number of officers familiar with the practical side of agricultural machinery. There were, however, obvious objections to this arrangement being made permanent and to the treatment of machinery research being kept separate from that of research in all other agricultural subjects.

In deciding to set up a separate research institute in agricultural engineering, the Ministry came to the conclusion that it would be preferable to attach such an institute to a University, rather than to establish a separate institute, and Oxford University was chosen for the purpose. That University has now accepted the proposal and an Agricultural Engineering Institute will accordingly function there from 1st April, 1924.

The University has chosen as the Director of this new Institute, Captain B. J. Owen, M.Sc., M.Eng. The effect of this choice will be that complete continuity of work on research problems in agricultural engineering will be secured, notwithstanding the transfer of such research from the Ministry to Oxford, since Captain Owen has, for some time, taken an important part in connection with the Ministry's machinery research.

While the responsibility for research and investigation will be transferred to Oxford University, the Ministry proposes itself to inaugurate a scheme for the testing of agricultural machinery. It proposes that tests should be carried out and certificates issued on its authority, but that the actual work of testing shall be conducted by the new Oxford Institute, the National Physical Laboratory, and other Institutions. It is expected that the testing scheme can be made self-supporting and that fees will be charged on this basis.

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Spraying of Fruit Trees with Arsenate of Lead: Danger to Bees.

THE Ministry again desires to bring to the notice of fruit growers throughout the country the danger to bees which may be caused by the spraying of fruit trees when in open blossom with washes containing arsenate of lead. It is not desired to discourage the use of arsenate of lead sprays, as these are of the greatest value in controlling the Winter and "Tortrix" moths, the larvæ of which are responsible for an enormous amount of damage to fruit trees. Spraying with this substance, however, should be restricted, as far as possible, to two definite periods, viz., before the blossom buds open and immediately the petals have fallen. In the case of apples, an application during the earlier period will give better results than at any subsequent time—especially against "Tortrix" moths. Spraying during the actual blossoming period is particularly to be deprecated on account of the fact that heavy mortality may be caused to bees visiting blossoms on which the spray has fallen. It is realised that, as the different varieties of fruit trees do not come into blossom at the same time, it may be a matter of some difficulty to arrange that no open blossoms whatever are sprayed, but instances have been brought to the notice of the Ministry of the indiscriminate spraying of open blossoms with lead arsenate, for which no reasonable excuse can be put forward.

Bees are of great value to the fruit grower by the assistance they render in the fertilisation of fruit blossoms, and in his

own interests, therefore, as well as for the sake of the bee-keeper, the fruit grower should spare no effort to avoid any unnecessary mortality among these beneficial creatures.

* * * * *

THE Ministry has received the concurrence of the Treasury in its proposals to carry out practical experiments at the South

**Experiments in
Table Poultry
Breeding.**

Eastern Agricultural College, Wye, Kent, in the breeding of poultry for table use. The objects of the experiments will also cover the disposal of the surplus stock of birds on commercial egg farms. In the first place experiments will be undertaken :

(1) To ascertain the weight and value of weight gained by various breeds and cross breeds of poultry in relation to the weight and value of food consumed; also the feeding costs of finishing fowls for the table and the best breeds or cross breeds to use for this purpose.

(2) To ascertain the most profitable methods of feeding and marketing birds produced as a by-product on commercial egg farms.

(3) To ascertain the value for table purposes of the breeds most generally used by commercial egg farmers, as compared with the breeds and cross breeds usually regarded as best for table use; also, whether it is likely to be profitable for commercial egg farmers to continue producing chickens for table use, from the birds they usually keep, at times of year other than the usual season for hatching laying fowls, and if so, what are the best methods of feeding and marketing the birds.

The experiments will be begun with a small number of breeding pens composed of the following breeds and cross breeds:—White Leghorn, White Wyandotte, Rhode Island Red, Light Sussex, Indian Game crossed with Light Sussex, and Silver Grey Dorking crossed with Light Sussex. All suitable eggs laid by these birds will, if practicable, be incubated during the whole of the first year of the experiments. The chickens from each breed and cross breed will be divided into four lots and marketed as:—(a) “petits poussins”; (b) chickens off the run; (c) trough-fed chickens; and (d) chickens fed by cramming.

The Governors of Wye College have generously provided a site for the experiments on the College farm, and have provided other facilities in connection with them. The investigations are to be carried out as part of the National Poultry Institute Scheme, and the programme has been formulated and the site

for the experiments selected by a Sub-Committee of the Ministry's Poultry Institute Advisory Committee. That Sub-Committee will also be responsible for the conduct of the experiments, and for the issue from time to time of reports on the progress of the work. Four of the six existing members of the Sub-Committee are nominees of the National Poultry Council. The Chairman is Principal R. M. Wilson, M.A., B.Sc., of Wye College, and the other members are Mr. Harold Corrie, Mr. J. H. Dowden, Mr. A. P. F. Grant, Mr. Nelson Kenward (nominated by the Ministry), The Revd. H. Mayall, Mr. A. S. Juniper (co-opted by the Sub-Committee), and one member remains to be appointed.

* * * * *

THE Director of Rothamsted Experimental Station extends a cordial invitation to Farmers' Associations and Clubs,

**Farmers'
Visits to
Rothamsted
Experimental
Station.**

Chambers of Agriculture and Horticulture, Students' Societies and other bodies interested in agriculture or market gardening to inspect the Experimental Plots during the coming summer. Mr. H. V. Garner, B.A. (Camb.), will be available to demon-

strate the Plots at any time, and all who come can be certain that under his guidance their visit will prove both useful and interesting.

Among important items of interest are: experiments on the manuring of arable crops, especially wheat, barley, mangolds and potatoes; manuring of meadow hay; effect of modern slags and mineral phosphates on grazing land, hay land, and arable crops; crop diseases and pests; demonstrations of good types of tillage implements, tractors, etc. At any convenient time between now and 30th October there is sufficient to occupy a full day, and there is provision for ensuring that the time shall not be lost, even if the weather turns out too bad to allow of close investigation of the fields.

The Director of the Station, Sir John Russell, will be happy to arrange full details with organisations of farmers, farm workers and others wishing to accept this invitation; small groups of farmers are specially welcomed. If possible, arrangements should be made beforehand; but it is recognised that farmers' movements must often depend on the weather, and no farmer need stay away because he has been unable to write fixing a date.

All communications and requests to visit the Station should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts. It would be a convenience if

ample notice could be given so as to avoid the possibility of dates clashing.

* * * * *

Foot-and-Mouth Disease.—Since the last issue of the *Journal*, the position in regard to this disease has materially improved, the number of outbreaks during the weeks ended 30th March, and 6th, 13th, 20th and 27th April being respectively 36, 28, 14, 16 and 9.

During that period, the following new centres of disease were brought to light, namely, Enfield (Middlesex) on 6th April, which involved an extension of the infected area; Pluckley, Ashford (Kent), on 11th April, involving an extension of the existing area in Kent; Saxham, Bury St. Edmunds (Suffolk), on 13th April, also involving an extension of the existing area; Great Smeaton, Yorks (N.R.) on 20th April, the circumstances of which necessitated a large area in the North and West Ridings, as well as a part of Durham, being declared infected, as Northallerton and Halifax markets were involved; at Glasgow on 22nd April, necessitating an infected area being declared, including parts of Lanark, Dumbarton, Stirling, Renfrew and Ayr; and at Northolt, Middlesex, on 23rd April, infected area restrictions being imposed over a 15 mile area in consequence.

Recurrences of disease have also taken place in the Hendon district of Middlesex and the Gamrie district of Banffs, the latter on the 16th April, necessitating the reimposition of restrictions over the usual 15 mile area in Aberdeen and Banff.

The limits of several infected areas have been reduced in consequence of the much improved position.

The position from the 27th August, 1923, to the 27th April is as follows:—

Number of outbreaks	...	...	3,064
Counties affected:—In	England	...	39
	„ Wales	...	2
	„ Scotland	...	11
Animals authorised to			
be slaughtered	...	Cattle	102,917
		Sheep	42,904
		Pigs	47,656
		Goats	125

Foot-and-Mouth Disease: Standstill Order not to be issued:—During the past fortnight the Minister has had under consideration representations made to him in favour of the imposition for a period of three weeks of a “Standstill” Order for all cattle, sheep, pigs and goats with the object of hastening the eradication of foot-and-mouth disease.

To be effective for the purpose in view the Ministry considers that it would be necessary—

- (a) to maintain an Order of this kind in operation for at least 28 days;
- (b) to apply it to the whole of the infected areas, which include nearly all the Midland and Northern counties of England as well as certain Southern and Eastern counties and also parts of Scotland; and
- (c) to apply the Order not only to store animals but also to those intended for slaughter, inasmuch as the experience of recent months has shown that the movement of fat stock is attended by as great a danger of the spread of infection as that of store stock.

This would mean that fat stock would not be allowed to be removed alive for slaughter but would have to be killed and dressed on the farm, and that the urban centres would have to set up some organisation to ensure an adequate meat supply for their populations.

The prohibition of the movement of store stock also, even with modifications to admit of purely local movements by licence for the essential purposes of milking, feeding, and for emergencies, would especially at this time of the year be attended by grave inconvenience to farmers engaged in restocking their farms and in arranging for the return of sheep from their winter quarters. To this must be added the heavy losses which would result to the distributive branches of the livestock industry, and therefore to the consumer, from the application of the Order.

The Minister has carefully reviewed all the circumstances for and against the adoption of this expedient, and has come to the conclusion that he would not be justified in imposing upon the public an Order of so onerous a character as that proposed. Moreover, the Ministry thinks that the enforcement of such an Order would be found to be impracticable, and that even if an attempt to enforce it were made, it would not be possible to guarantee the desired results. The Minister has therefore definitely decided against the issue of a Standstill Order.

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International Dairy Exhibition in Argentina.—In a note in this *Journal* for January, 1924, p. 974, it was announced that an International Dairy and Refrigerating Machinery Exhibition would be held at Buenos Aires in May, 1924. The exhibition has been postponed to 1st September, 1924.

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Leaflets issued by the Ministry.—Since the date of the list given on pages 770-771 of the November issue of the *Journal*

The following new leaflets have been issued:—

- No. 7.—The Wheat Bulb Fly.
- „ 310.—Seed Mixtures for Grassland and Some Directions for Laying Down to Grass.
- „ 311.—Agricultural Credit Societies.
- „ 314.—The Bacon Pig.
- „ 316.—Lavender: Its Cultivation for Marketing and Distilling.
- „ 318.—Currants.
- „ 323.—The Cultivation and Marketing of Cabbage and Savoys.
- „ 359.—Brussels Sprouts.
- „ 391.—Barley Growing.

The following Leaflets have been re-written:—

- No. 80.—The Use of Artificial Manures.
- „ 132.—Slugs and Snails.
- „ 150.—Pea and Bean Beetles.
- „ 259.—Swift Moths.
- „ 283.—The Storage of Apples and Pears, Commercial Storage.
- „ 320.—The Manuring of Vegetable Crops.

The following Leaflets have been revised:—

- No. 5.—Mangold Fly.
- „ 114.—The Scientific Principles of Feeding Poultry.
- „ 146.—The Value of Records of the Milk Yields of Cows.
- „ 187.—The Selection and Milking of Dairy Cattle.
- „ 254.—The Use of Seaweed as Manure.
- „ 297.—Seed Testing. The Seeds Act, 1920, and Seeds Regulations, 1922.
- „ 329.—Redemption of Tithe Rentcharge and Corn Rents: The Tithe Act, 1918.
- „ 400.—List of Publications.

The following leaflets have been amended:—

- No. 244.—The Destruction of Rats.
- „ 395.—Diseases of Adult Bees. (Addendum on Acarine Disease.)

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NOTICES OF BOOKS.

The Possibilities of British Agriculture.—(Sir Henry Rew and Sir E. J. Russell. London: John Murray. 1s. net, with Foreword by Lord Bledisloe.) This book is a reprint of a joint paper read at the meeting of the British Association at Hull.

At the outset tables are given showing the food requirements of the nation and the contribution thereto made by the home producers. The figures, taken as a whole, indicate that about half the nation's food is grown in Great Britain. Certain commodities, however, *e.g.*, milk, potatoes, vegetables and certain fruits are almost wholly produced in this country; on the other hand, our production falls short to the extent of 75 per cent. to 55 per cent. in respect of such articles as wheat, meat, eggs and dairy produce. While, therefore, we can, and do, produce sufficient fresh milk, potatoes and vegetables for our needs, the authors are careful to point out that this self-sufficiency depends on the provision of some effective means of disposing of surplus produce.

In regard to cereals and meat, the possibility is suggested of considerably increased production; "if low wages could still continue to be paid to agricultural labourers, the Norfolk system, improved in its details, would give us a larger food supply than we now have." This the authors recognise to be impossible, and they proceed to examine certain alternative courses having as the central idea—increased output per man:—(a) better drainage, (b) fuller use of lime, (c) a more efficient use of artificial fertilisers, (d) the use of improved varieties of crops, (e) the eradication or abatement of plant diseases or pests, etc.

The authors seem to favour a cautious and gradual break away from the Norfolk four-course rotation and comment favourably on the Northumberland five-course modification, whereby it is suggested that farmers obtain the same total quantity of roots and corn and "have, in addition, a field of hay."

Finally, a plea is entered for more examples of large scale farming, with specialists in charge of the several departments, as in other important industries, and the paper concludes on an optimistic note derived from the increasing interest displayed in agricultural education by landlords, farmers and farm-workers.

Commercial Tomato Culture.—(The Lea Valley Correspondent of "The Fruit Grower." London: Ernest Benn, Ltd. Price 2s. 6d. net.)

This is clearly a book written by a practical man who has kept in close touch with the development of scientific knowledge. It covers the widest possible range, from choice of site to all the processes of building, heating, soil treatment, growing, marketing, dealing with diseases, and organisation of labour.

The writer aims at high results—sixty tons of fruit per acre—and estimates the cost of steam sterilization at £240 per acre. His advice is good and thoroughly up-to-date, and it must be a most useful little book for beginners in tomato culture who have a sufficient foundation of knowledge upon which to build.

Modern Pig-Keeping.—(H. P. Jacques. London: Cassell & Co. Price 1s. 6d.) This is a concise little volume packed with useful information clearly set out. It is mainly a collation of material which has appeared from time to time in the Agricultural Press from the pens of well-known breeders and feeders of pigs, tempered by the author's own experience in Western Canada and Rhodesia.

The book opens with a description of the more important factors which have contributed to the success of the Danish system of co-operative bacon factories, and ventures the prediction that before long the enormous importation of bacon, pork, etc., will be a relict of the past. It may, however, be doubted whether the author is fully alive to the part played in this connection by the by-products of the Danish dairy.

In an interesting statistical table it is shown that in 1922 the import of bacon, ham, pork and lard into the United Kingdom from, chiefly, United States of America, Denmark, Canada, Netherlands and Argentina reached the sum of £55½ million, equal to 27 lb. per head of the population!

The author is a keen, if temperate, supporter of the open-air system of pig-keeping, and his advice to those about to keep pigs is rational and sound. Farrowing and Weaning, Foods and Feeding, Rationing and the Common Pig Ailments, are all dealt with in an interesting and informative manner, and we have no hesitation in recommending this inexpensive and well-got-out little book to all interested in the subject of pigs.

Animal Nutrition.—(T. B. Wood, C.B.E., M.A., F.I.C., F.R.S. London: University Tutorial Press Ltd. 4/6 net.) In a former volume—*The Chemistry of Crop Production*—Professor Wood dealt with the relations between plants and the air and soil, and showed how crops may derive all the simple substances they need for their nutrition. He now goes a step farther and discusses how these simple substances are built up and stored in the plant and used for the feeding of animals.

It is a fascinating story that appeals to the intelligence rather than the memory, and is in every way a noteworthy addition to agricultural literature. Nothing could be better adapted for the teacher and the student, while the farmer himself will find that a somewhat complicated and difficult subject has been made clear and interesting.

In regard to the question of feeding standards the author briefly reviews the pioneer work of Thaer, Wolff, Lehmann, Lawes and Gilbert, Kellner and Armsby, and arrives at a method of computing rations according to the result that the feeder desires to produce. The farmer will be interested to learn that in many cases his rations are needlessly high in protein, the ingredient usually present in smallest amount in home-grown foods and the most expensive to buy.

The feeding of the various classes of farm animals is dealt with in turn. That of dairy cows, which has of late received the most attention, has more than justified the system suggested, but it seems probable that similar benefits are to be derived from the same system as applied to fattening cattle, sheep and pigs.

No book on the feeding of animals would now be considered complete without some reference to vitamins. The reader will here find the subject dealt with in a manner that appeals to reason and common sense.

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ADDITIONS TO LIBRARY.

Field Crops.

Hutcheson, T. B., and Wolfe, T. K.—The Production of Field Crops : A Text-Book of Agronomy. (514 pp.) New York and London : McGraw-Hill Publishing Co., 1924, 17s. 6d. [63.3(02).]

Indiana Agricultural Experiment Station.—Bulletin 272 :—A Study in the Cost of Producing Wheat and Oats. (24 pp.) Lafayette, 1923. [63.311; 63.314.]

U.S. Department of Agriculture.—Department Bulletin 1183 :—Milling and Baking Experiments with American Wheat Varieties. (92 pp.) Washington, 1924. [664.6; 63.311.]

Chilean Nitrate Committee.—Profitable Cultivation of the Sugar Beet. (11 pp.) London, 1924. [63.3432.]

Horticulture and Fruit Growing.

Indiana Agricultural Experiment Station.—Bulletin 266 :—Greenhouse Soil Sterilization. (24 pp.) Lafayette, 1922. [63.115; 63.5—19.]

Indiana Agricultural Experiment Station.—Bulletin 274 :—Pruning Young Apple Trees. (40 pp.) Lafayette, 1923. [63.41—195.]

Wisconsin Agricultural Experiment Station.—Bulletin 360 :—Strawberry Culture. (24 pp.) Madison, 1924. [63.41(c).]

Plant Pests and Diseases.

U.S. Department of Agriculture.—Farmers' Bulletin 1371 :—Diseases and Insects of Garden Vegetables. (46 pp.) Washington, 1924. [63.24—51; 63.27—51.]

Oregon Agricultural Experiment Station.—Bulletin 201 :—The Preparation of Spray Materials. (15 pp.) Corvallis, 1924. [63.295.]

Live Stock.

Jacques, H. P.—Modern Pig Keeping. (117 pp.) London : Cassell & Co., 1924, 1s. 6d. net. [63.64.]

Kentucky Agricultural Experiment Station.—Bulletin 242 :—Feeding Steers Having Access to Barn and Range versus Steers Confined to Barn. (22 pp.) Lexington, 1922. [63.62 : 043.]

Kentucky Agricultural Experiment Station.—Bulletin 243 :—Breeding Experiments with Kentucky Mountain Ewes. (64 pp.) Lexington, 1922. [63.631.]

Dairying.

Vermont Agricultural Experiment Station.—Bulletin 225 :—Protein Requirements of Dairy Cows. (200 pp.) Burlington, 1922. [612.394; 63.711.]

Vermont Agricultural Experiment Station.—Bulletin 226 :—The Maintenance Requirements of Dairy Cattle. (191 pp.) Burlington, 1922. [612.394; 63.711.]

Poultry.

Kentucky Agricultural Experiment Station.—Bulletin 250 :—Calcium Metabolism in the Laying Hen. (38 pp.) Lexington, 1923. [63.651.]

Indiana Agricultural Experiment Station.—Bulletin 275 :—Temperature Experiments during the Incubation of Hen Eggs. (16 pp.) Lafayette, 1923. [63.65(041).]

U.S. Department of Agriculture.—Farmers' Bulletin 1377 :—Marketing Poultry. (30 pp.) Washington, 1924. [63.753.]

U.S. Department of Agriculture.—Farmers' Bulletin 1378 :—Marketing Eggs. (28 pp.) Washington, 1924. [63.741.]

Economics.

Institute for Research in Agricultural Economics.—Miscellaneous Papers in Agricultural Economics. Vol. II, 1919-22. Oxford, 1923. [338.1.]

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

Vol. XXXI. No. 3.

JUNE, 1924.

NOTES FOR THE MONTH.

THIS Report,* which has just been published by H.M. Stationery Office, is likely to be of interest not only to farmers, but to all who are interested in manufacturing, buying or selling manures and feeding stuffs.

Report of Committee on the Fertilisers and Feeding Stuffs Act, 1906.

The substance of the Report is contained in Parts II and III. In Part II the Committee sets out the results of its examination

of the objections levelled at the Act of 1906. From the farmer's standpoint, the main complaint is that if he calls in the official sampler with no object other than to see that he is getting goods of the quality he is paying for, he may be drawn into criminal proceedings taken by the Local Authority against his supplier, and that consequently many farmers prefer not to use the Act at all. The average farmer, like most other individuals, is anxious to avoid appearance in a police court, even as a witness for the prosecution, and particularly so if the defendant is an acquaintance with whom he has been dealing for many years.

The difficulties of manufacturers and traders are next dealt with. They have always protested against being held criminally liable in respect of goods which have passed out of their control. The Report also refers to the administrative problems that present themselves to Local Authorities in carrying out the provisions of the existing Act. As the Committee points out, it is too frequently the case, at present, that where clear evidence of adulteration or misrepresentation is available, the Local Authority finds itself unable to fulfil all the technical requirements of the Act and Regulations while where all the preliminary

* Cmd. 2125, price 1s. ; 1/1d. post free.

formalities are complied with, the defendant is able to show that he was not primarily responsible; in either case, trouble and expense are incurred with no corresponding advantage to the agricultural community.

The essential recommendations made by the Committee in the hope of removing the present difficulties may be summarised as follows :—

(1) Farmers should be relieved of all connection with the enforcement of the criminal provisions of the Act. To effect this, the statements in the invoice should be a warranty for civil purposes only, and there should be no prosecutions in respect of samples taken on the farm. At the same time, the period within which such samples must be taken should be extended, and the requirement that notice must be given to the seller should be withdrawn. The result should be a substantial increase in the number of samples taken on the farm, and, if a large number of samples are taken for the purpose of checking the warranty and obtaining compensation for any deficiency, misrepresentation will become less profitable and, therefore, less common.

(2) A description should be applied to every consignment of fertilisers and feeding stuffs sent out from premises where such goods are manufactured, stored or sold, and samples should be taken as often as may be necessary on such premises by authorised officers of the Local Authority. Criminal liability should attach to the application of a false description, but, in view of the great facilities for sampling afforded by the proposed arrangement and in order to avoid possible injustice to sellers, there should be no prosecution except in respect of a sample taken on the premises of the person to be charged. In a word, the official control of these articles should operate at the point of origin instead of after distribution over a wide area and in some cases to remote localities, thus increasing the efficiency of that control in relation to its cost.

(3) The scope of the Act should be defined by means of schedules showing the articles to which the Act applies, the definition of each article, and the particulars required to be given in respect of each in the invoice and in the description applied to the goods. The schedules, which, though included in the proposed new Act, should be capable of amendment by Regulation, would allow provision to be made for the peculiar requirements of each class of articles.

(4) An Advisory Committee should be set up to prepare the schedules mentioned, to review the present Regulations and to advise on technical questions arising out of the administration of the Act.

There are a number of other proposals which, though of a less sweeping character, are nevertheless important.

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BRITISH dairying is represented at the British Empire Exhibition, Wembley, by:—

**Dairying at
the British
Empire
Exhibition.**

1. A modern cowshed, in which are stalled ten deep-milking British Friesian cows.

2. An exhibit of the accommodation and equipment necessary for the handling and dispatch from the farm of milk of the highest hygienic quality, such as milk qualified for sale under the Milk Designations Order as a Graded milk.

3. A Working Country Dépôt which illustrates in a practical manner the type of work going on in the farmhouse dairy or in the country dépôt where milk is manufactured into dairy products.

4. A Milk Distributing Dépôt which illustrates the latest advance in the provision for the handling of milk in a town distributing-dépôt where milk is pasteurised, chilled and bottled with the utmost despatch and efficiency.

5. A research exhibit in the Government Pavilion, organised by the Ministry of Agriculture.

The plot of land on which the Working Dairy stands was acquired by the Ministry of Agriculture and placed at the disposal of the National Milk Publicity Council, who undertook that it should be devoted, under their responsibility, to an exhibition of British dairying.

The area available, namely 7,000 square feet, was considered by the Council insufficient to accommodate both the Working Dairy and the Cowshed in which the handled milk is produced. It was therefore decided to devote the whole of the space to the Working Dairy. With the object, however, of providing an adequate representation of milk production and incidentally of British breeds of dairy cattle, the National Milk Publicity Council invited to a meeting representatives of all the British breeds of dairy cattle, at which the Council suggested that the Breed Societies, acting jointly, might rent a piece of land adjoining the Working Dairy, on which to erect a modern cowshed of sufficient size to accommodate such numbers of cows representative of the different breeds as the Societies themselves might decide to have maintained at the Exhibition. The result of the Conference was, however, that the British Friesian Society was the only Society which decided to proceed with the proposal. For this reason the only breed of dairy cattle actually represented in that section of the Empire Exhibition which has to do with British dairying is the British Friesian.

It is a matter for regret that of the several excellent British breeds of milch cattle only one is exhibited. The cows are being housed, fed and milked in accordance with the most approved methods, and those who are interested in the subject should, by examination and inquiry on the spot, be able to obtain useful information.

The milking, together with the handling of the milk, will completely illustrate an approved method of procedure in the case of a farm producing one of the grades of milk specified in the Milk Designations Order.

The small dairy attached to the cowshed shows such milk being bottled for direct distribution from the farm, and also the dispatch in bulk to a Grade distributing centre.

The Working Dairy is divided into two distinct parts (1) the one representing the dairy at the source of production, and (2) the other the dairy which has to do with distribution. The former is being conducted under the direct supervision of an Exhibition Sub-Committee of the National Milk Publicity Council, but the Council arranged with the National Federation of Dairymen that they should organise and conduct the latter.

The home dairy section may be regarded as typical of the work which goes on in a variety of dairies attached to milk-producing farms, and also in a certain measure as indicative of the work of a country dairy depôt in which the manufacture of milk products is the chief business. The dairy is managed by a regular staff consisting of a manager and three trained dairy maids. This staff will be assisted throughout by a rota of experts attending to give a series of special demonstrations (see p. 213).

The daily work of this section is concerned with the manufacture of certain varieties of dairy produce for which this country is renowned, but in view of the wealth of varieties which have their origin in Great Britain it is impossible on each day to provide examples of the manufacture of each. Arrangements have been made, however, for the daily programme to be gradually modified so that every type will, from time to time, be under demonstration. For example, the production of the following commodities is included in the programme: (1) the production of cream for sale—including single, double, Devonshire, Cornish and other types of cream; (2) the manufacture of butter; (3) the manufacture of Cheddar, Cheshire, Lancashire, Derby, Leicester, Gloucester, Dunlop, Caerphilly, Stilton, Wensleydale, Small Holder, soft, cream, and other cheeses.

The whole of these products will be offered for sale to the attending public as soon as they are manufactured, or as they become ripe, and it is hoped that those who visit the Exhibition will make use of the opportunity not only to see the most approved methods of manufacture but to obtain at the source of production examples of British produce manufactured in accordance with the most approved principles.

In addition, the Ministry of Agriculture, at the request of the National Milk Publicity Council, have obtained the consent of certain County Education Authorities to the loan of their expert instructors to conduct special short-period demonstrations in the manufacture of British dairy products. In this manner the specialists will, it is expected, act in accordance with the following programme:—

<i>Period.</i>		<i>Special Demonstration.</i>	<i>Expert.</i>
<i>Mth. From.</i>	<i>To.</i>		
May 1st	17th	Small-Holder Cheese-making	Miss Williams, N.D.D.
May 19th	31st	Cheshire Cheese-making	Miss Bennion, N.D.D.
June 2nd	7th	Derby Cheese-making	Miss Wood, N.D.D.
June 9th	14th	Leicester Cheese-making	Miss Wood, N.D.D.
June 16th	28th	Cheddar	Miss Saker, N.D.D.
June 30th	July 5th	Lancashire	Miss Stubbs, N.D.D.
July 7th	12th	Dunlop	To be appointed.
July 14th	26th	Double and Single Gloucester	Miss Jackson, N.D.D.
July 28th	Aug. 2nd	Soft Cheeses	Miss Matthews.
Aug. 4th	9th	Soft Cheeses	Miss Coward.
Aug. 11th	23rd	Fresh Cream	Miss Nicholas.
"	"	Devonshire Clotted Cream	Miss Nicholas.
"	"	Cornish Clotted Cream	Miss Nicholas.
Aug. 25th	Sept. 6th	Caerphilly	Miss Taylor, N.D.D.
Sept. 8th	20th	Cream Cheeses	Miss McLeod, N.D.D.
Sept. 22nd	Oct. 4th	Butter-making	Miss Poles, N.D.D.
Oct. 6th	18th	Wensleydale and Stilton	Miss Boyes, N.D.D.

As each special demonstration is in progress there will be on exhibition and sale produce of the type which the process is designed to produce.

Visitors to the Exhibition will have an opportunity of seeing in operation, in that section of the dairy designed to show a modern milk distributing centre, a complete set of equipment designed to handle with the utmost expedition milk which is submitted to pasteurisation, chilling and bottling before it is distributed to the consumer.

The importance which is now attached to cleanliness and expedition in the handling of milk and in the manufacture of milk products are matters of vital concern to the public and are daily becoming more and more realised. It is therefore fitting that the Working Dairy at the British Empire Exhibition should make a point of illustrating in the completest manner possible the most modern methods of conducting the industry.

THE Ministry has addressed a circular letter to Local Education Authorities inviting them to consider the desirability of establishing co-operative schools in suitable dairying districts during the coming spring and summer of 1924. The schools are an educational measure preparing for the co-operative organisation of farmers in a district for dealing with "surplus" milk.

**Co-operative
Dairy Schools.**

In several counties of England and Wales, co-operative dairy schools have been established, and the Ministry of Agriculture is anxious to see the movement extended. With this object, the Ministry is prepared to pay a two-thirds grant under the Educational Grant Regulations to Local Authorities towards the cost of each school, which for the two or three months of its existence is estimated at £75 to £100. The schools already started have often achieved definite success, and have led to the setting up of co-operative societies for the manufacture of cheese and other dairy produce. The Departmental Committee on Prices of Agricultural Produce referred to the advantages to be gained by the co-operation of dairy farmers for the manufacture of surplus milk into cheese, etc., and urged the extension of the scheme for the establishment of co-operative dairy schools. The Ministry holds that the present is an opportune time for the extension, having in view the fact that the Government has lately set aside a considerable sum of money for the express purpose of assisting the development of co-operative enterprise among farmers.

Under the scheme, the initial steps are taken by the Local Authority, which lends apparatus for the purpose (supplied by the Ministry free of charge) and provides a skilled instructor and advice. The farmers of the district agree to supply milk to the school on a strictly co-operative basis, i.e., the price depending on the ultimate sales of cheese, and also to engage a suitable person to assist the instructor with a view to the former becoming qualified to undertake the management of the co-operative factory, if one results from the school. The school is run for two or three months, or until such time as the Local Authority is satisfied that the principles of co-operation have been thoroughly demonstrated. The farmers concerned must then decide whether or no they will carry on the work performed at the school as a properly constituted co-operative society without further assistance from the Local Authority.

Out of 66 co-operative schools held since the scheme was started in 1916, 40 independent societies have been established.

* * * * *

TEN square rods of land amount to but a small area, but when used as an allotment even this area brings the cultivator into continued and close contact with mother earth and all her soothing effects on both mind and body. The cultivation of an allotment provides a means of open air recreation of a peaceful and profitable nature within the reach of all classes.

**Model Allotment
at the British
Empire
Exhibition.**

For many it provides supplies of potatoes, vegetables and small fruits in their very freshest state, and in sufficient quantities for a small household for fully thirty weeks of the year, while it is the more attractive because of the flowers it produces for beautifying the home. The wonder, then, is that the number of allotment holders in this industrial country of ours is not larger than the million or so often mentioned. Some of these allotment holders, no doubt, have been associated with the land from youth upwards and are well competent to wrestle successfully with nature and to make the soil yield satisfactory crops without outside help and advice. Most allotment holders, however, are town dwellers who lack these early connections and are handicapped through want of knowledge. Their early training as railway workers, miners, cotton spinners, ship-builders or mechanics, will have given them few opportunities for studying soil tillage or plant culture, but they will have learnt that successful results can generally be achieved by working on correct lines. Urban allotment holders therefore look for reliable information from the Ministry and from County Agricultural Education Committees.

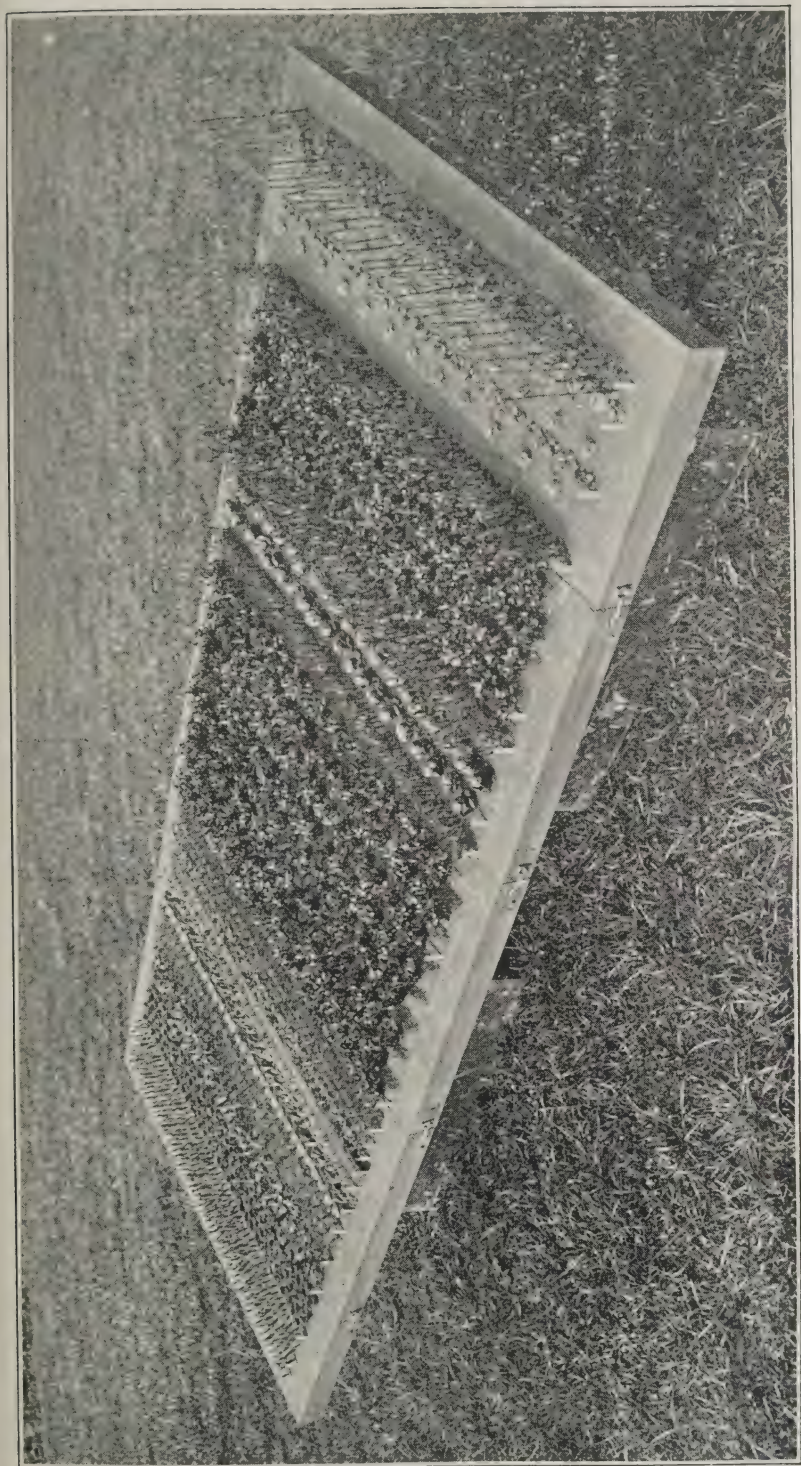
The allotment movement is regarded as so important that the Ministry considered it desirable to construct a model of a demonstration 10-rod allotment on a scale of $\frac{1}{2}$ in. to 1 ft. for exhibition at the British Empire Exhibition at Wembley. The construction of a model to show growing plants is never easy, and the difficulties increase as the scale diminishes. For this model it was necessary to find diminutive plants similar in growth to the

allotment vegetables and one-twelfth the size. Within limits this has been done; lichens to represent lettuce; box (*myrtifolia*) for potatoes; box (*incarva giganteum*) for cabbage and Brussels sprouts; *Lycopodium* for peas; *Ficus* for runner beans; laurel for dwarf beans; rushes for onions; flax for leeks; *Cupressus* for carrots; *Potentilla* for turnips, etc. These plants had to be killed and the leaves and stems fixed to secure permanent specimens, then coloured with dyes approximating to the colours of the growing plant which they represent. This has been done for all plants of the 10-rod allotment, and the model is now exhibited in Case K of the research exhibit in the Agricultural Gallery of the Government Pavilion at Wembley. The illustrations herewith give some impression of the general "lay-out" of the allotment. The model is divided into three parts, which can be re-arranged to show the proper annual rotation of the crops.

The 10-rod allotment must be treated in an intelligent way, and cropped in a sound manner under a proper rotation of crops, in order to ensure good tillage, make the most economic use of plant foods, and guard against damage by plant pests—which is likely to occur wherever the land is cropped continually with the same classes of plants. The cropping must be carried out on a settled plan which, with slight variations, must be persistently followed year by year.

The best plan of cropping to give satisfactory results has been carefully considered by experts on several occasions, and their decisions are incorporated in the Ministry's Leaflet, No. 315 (*Suggestions and Chart for the General Cropping, Manuring and Cultivation of Allotments*). This leaflet has been very popular, for no fewer than 110,000 copies have been distributed since its introduction in September, 1920.

In order to assist further, the Ministry arranged, in recent years, for some County Committees to establish demonstration allotments to show the system of cropping and the quantity of food that could be produced from them. On the demonstration allotments in the Counties of Middlesex, Bucks and Kent, the following average crops were produced:—potatoes 326 lb., parsnips 60 lb., turnips 60 lb., beet 46 lb., carrots 40 lb., shallots 76 lb., peas 20 lb., runner beans 55 lb., French beans 60 lb., broad beans 24 lb., Brussels sprouts 30 lb., savoy 35 lb., cabbage 50 lb., kale 42 lb., cauliflower 20 lb., spinach 20 lb., lettuce 20 lb., rhubarb 30 lb., marrows 28 lb.



The Ministry's Model Allotment at the British Empire Exhibition.

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SOIL IMPROVEMENT: FERTILISERS AND THEIR USE.

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THE value of artificial fertilisers was discovered at Rothamsted eighty years ago in a few extraordinarily simple pot and field experiments made in the first instance by Lawes and afterwards by Lawes and Gilbert. The famous Broadbalk experiment is perhaps the best known of these. It was well known that farmyard manure increased the yield of crops, but no chemist was able to say why: some considered the effect was due to the combustible or organic part of the manure on the principle that this was of like nature with the plant; others supposed that only the ash or mineral constituents were effective, while others again considered that nitrogen compounds played a part. To distinguish between these rival hypotheses Lawes and Gilbert laid out four plots in the Broadbalk wheat field; to one they added farmyard manure, to a second they gave the ashes from an equal quantity of farmyard manure, to a third they applied a nitrogen compound in addition to the ash constituents, and the fourth was left unmanured. Had the ash constituents been the real fertilising agents the second plot should have given as good results as the first; had the organic matter been the effective fertiliser none of the plots should have equalled the first; if, however, the fertilising value lay in the ash constituents *plus* nitrogen compounds then the third plot which received this mixture should have yielded as well as the one receiving farmyard manure.

The experiment was conclusive; the results were:—

Lawes & Gilbert experiment with Wheat, Broadbalk Field, 1843-4.

						<i>Yield of Grain.</i>
						<i>Bush. per acre.</i>
Farmyard manure, 14 tons per acre	...	...	...	...	...	22
Ashes of 14 tons farmyard manure	...	...	...	...	...	16
Mineral manures and nitrogen compounds	...	...	...	...	...	26½
No manure	...	...	...	...	...	16

It thus appeared that the fertilising value of farmyard manure lay in its mineral constituents *plus* nitrogen compounds. Now this was an interesting scientific discovery, but Lawes saw that he could develop it on the practical side; it was not necessary to burn farmyard manure for the purpose of obtaining the ash constituents; these could be obtained in large

quantities from other sources while the nitrogen compounds could be obtained from gas works in the form of sulphate of ammonia. Accordingly Lawes and Gilbert laid out plots to test these artificial fertilisers on the various farm crops, and the plots have furnished and continue to furnish such valuable information that they are maintained to this day with only such changes as Lawes and Gilbert themselves made in the course of their work.

Since the original discovery of Lawes and Gilbert, chemists have been busily engaged in making an extensive and well classified list of substances which can be used as fertilisers. These substances fall into three groups; nitrogenous, phosphatic and potassic. Each of these groups, besides contributing in a general way to plant growth, has some definite specific effect on the crop which the farmer can often use to his advantage.

Nitrogenous Fertilisers.—The first with which we deal is the nitrogenous group, and includes nitrate of soda, nitrate of lime, sulphate of ammonia, muriate of ammonia, urea, and where used in that form, cyanamide. All these fertilisers increase the rate of leaf growth and so produce larger leaves and stems; they also induce a greater formation of green colouring matter, giving darker green crops. Farmers take advantage of these properties in several ways. Leafy crops such as cabbages and mangolds are liberally treated with nitrogenous manures in order to obtain as much growth as possible. Again, these manures are extremely useful where quick growth is wanted. Producers of early potatoes in Cornwall use dressings of nitrate of soda which would stagger the grower of main crop varieties; as much as 10 cwt. per acre is used, and the dressing is justified on the ground that it brings the potatoes more rapidly up to market standards and therefore assures the grower the high reward given to the man soonest ready. On ordinary farms this rapidity of growth is advantageous in dealing with certain insect pests; wherever the trouble can be minimised by making the plant grow more rapidly a dressing of nitrogenous manure should be tried. A further case where this effect is valuable is after a long cold winter when the plant is backward. It is true of crops as with human beings, that the child is father to the man, and a backward plant in late spring has little chance of growing into a heavy-yielding plant unless it is given some help.

As between the various nitrogenous manures there are certain properties which are sometimes of use and sometimes disadvantageous to the farmer. Nitrate of soda has the advantage of being one of the most rapid in action, of being easily obtainable, easily

handled, and well known to farmers. It is especially useful for hay, mangolds, cabbages, and for spring dressings of wheat and oats after a long winter. It is applied at the rate of 1 to 2 cwt. per acre and comes into action at once. Care is necessary in using it on heavy land, since the clay is liable to become deflocculated and to assume a sticky condition, but this trouble can be obviated by using a mixture of nitrate of soda and neutral sulphate of ammonia, applied immediately after mixing; not stored.

Nitrate of lime is also very rapid in action. It can be used on the same crops and in the same way as nitrate of soda; it is advantageous where the soil is deficient in lime, and, so far as the writer's experience goes, it has no ill effect on heavy soils.

Sulphate of ammonia is the most suitable nitrogenous manure for second early and main crop potatoes, on which it can be used in considerable amounts, even 3 or 4 cwt. per acre having proved profitable. It is very useful as a spring dressing for winter corn crops, and as a nitrogenous manure for barley. For other crops it is almost as effective as nitrate of soda and it is usually distinctly cheaper. Care is required in using it on land deficient in lime as it reacts with a certain amount of this constituent; one cwt. of sulphate of ammonia puts out of action about $\frac{3}{4}$ cwt. carbonate of lime. This property might prove of definite advantage on alkali soils where nitrogenous manures are wanted.

The other two nitrogenous fertilisers are new and not yet within the experience of the ordinary farmer; muriate of ammonia is quite promising; it is of the same character as sulphate of ammonia but is less suitable for dry conditions; it apparently behaves equally well, however, under a rainfall of 30 inches or more. It should not be mixed with muriate of potash for use in the eastern or midland parts of England; there is no visible harm either to the appearance of the fertiliser or of the crop, but on our present knowledge it appears that the efficiency of the fertiliser is lowered by the excess of chlorine.

Urea is a promising fertiliser and, being much more concentrated than any of the foregoing, it would be very useful where freightage is costly. It should, so far as we know, be drilled with the seed, and not be used as a top dressing, otherwise it is liable to a certain amount of loss.

Phosphatic Fertilisers.—These include superphosphate, the basic slags and the mineral phosphates. All have the effect of inducing root growth, hence their value for swedes and other

root crops. The quickest in action is usually superphosphate owing to the ease with which it dissolves in water, and it often produces striking effects. The most remarkable demonstrations in this country of its value are found in the Fens, where growers use large quantities, and it is usually the most effective fertiliser they have. Throughout the eastern counties there occur many other instances. In the Dominions perhaps the most striking effects are seen in South Australia, where very small dressings of superphosphate produce remarkable increases in the wheat crop. Larger dressings, however, give no better results.

In addition to improving the root development superphosphate also hastens the ripening processes, a very valuable action in cold, wet, or backward regions. It is used in the high Yorkshire wolds to expedite the wheat crop. These two effects render superphosphate very valuable on heavy arable soils, or on soils liable to be wet where the young plant has some difficulty in any case in getting a start, and where the ripening processes are apt to be unduly delayed. On the other hand, the need is less felt on dry sands where root growth and ripening go on quickly enough, and where indeed any hastening of ripening may reduce the yield. This contrast is seen in two experiments made at Woburn with barley in 1922, one on a low-lying rather heavy loam apt to be wet, the other on a light sand. The yields of grain per acre were :—

	<i>With superphosphate.</i>	<i>No superphosphate.</i>
At Woburn ; low-lying rather heavy loam	44.7	39.9
Do. light sand	34.6	38.4
In Suffolk ; light sand	21.6	27.9

At Woburn the withholding of phosphate was harmful in the case of the heavier soil but not on the lighter sand. A similar result was obtained on a light dry sand in Suffolk.

Among the most striking effects of phosphates are those on poor grassland on heavy soils—land which produces low yields of hay per acre and has only a small stock-carrying capacity. Basic slag, and more recently finely-ground mineral phosphates, have given remarkable results which are too well known to need description. It does not seem to matter what type of slag or of phosphates is used on poor grassland; with all types Dr. Scott Robertson obtained great improvement in Essex, and when costs and all other factors were taken into consideration it was sometimes difficult to say which phosphate had proved most profitable. The low-

soluble fluor-spar slags, however, were uncertain in their action. Some of his results are as follows:—

Weight of hay at Butterfields, Latchingdon. Manures supplying 200 lb. P_2O_5 per acre, sown December, 1915.

*Hay, cwt. per acre.
Average 5 yrs. 1916-20.*

No manure	...	...	...	...	20.5
Basic Bessemer slag	...	...	...	...	29.4
Gafsa rock phosphate	...	...	...	...	27.3
Open-hearth (fluor spar) basic slag	...	...	...	...	28.9
Open-hearth basic slag high citric soluble (1)	...	...	...	...	28.9
Open-hearth basic slag high citric soluble	...	...	...	...	32.3

When, however, one comes to somewhat better grassland it is less easy to obtain these striking effects; so far as we can tell at present the better the land the higher should be the grade of slag used. In the Essex experiments the rock phosphate was somewhat less effective than slag on the sweet soils, although there had been less difference on sour soils. as shown by the following table:—

Comparison of results on Sour and Sweet Soils.

Sour Soils:

Centre.	Lime requirement of soil. per cent.	Ph. value of soil.	Rock phosphate. Average cwt. per acre.	Basic slag. Average cwt. per acre.
Tysea Hill ...	0.29	5.7	30.5	30.9
Martin's Hearne	0.27	6.1	28.8	30.7*
Lambourne End	0.45	—	28.0	30.6*
Average ...	—	—	29.1	30.7

Sweet Soils:

Latchingdon ...	0.03	7.8	27.3	29.4
Saffron Walden	0.00	—	38.1	40.9
Horndon ...	0.00	7.7	19.5	23.4*
Average ...	—	—	28.3	31.2

*Open hearth high-soluble slags.

The contrast between the effects on poor and on good land is shown in the following Rothamsted figures, where it is seen that both the high- and the low-soluble slags, and the finely-ground mineral phosphates, have improved the yields of hay on the poor land, but that none of them has increased the yield on the better land, although the high-grade Bessemer slag had improved the quality of the herbage so that there was a gain in live weight of sheep.

Poor Grassland; 11 cwt. hay only per acre.

	1922. Cwt. per acre.
Control ...	10.9
Open-hearth slag, 90 per cent. soluble...	16.5
" " 30 per cent. soluble...	18.7
Gafsa phosphate ...	18.8

*Better Grassland ; 1-1½ tons hay per acre.**

	Yield of Hay, cwt. per acre.		Live weight increase in sheep, lb. per acre.	
	1921.	1922.	1921.	1922.
Bessemer slag	24.3	17.3	59	143
Open-hearth, high-soluble	23.9	16.6	43.3	112
Control	—	—	59	116
Open-hearth, low-soluble	26.5	21.1	67.3	123
Gafsa	25.4	22.5	88	107
Control	26.4	20.1	90	115

*The slags used on the grazing land were not identical with those used on the hay land, but they were of similar types.

Potassic Fertilisers.—The third great group of fertilisers is the potassic, and these are of special importance for the cow keeper and the potato grower. Part of their value to the cow keeper lies in the fact that they greatly increase the yield of mangolds and the quantity of sugar contained therein. The gain in yield has been repeatedly shown: 1 cwt. sulphate of potash or its equivalent in kainit has given 2½ or more tons per acre additional yield; the gain in sugar is periodically demonstrated at Rothamsted by analyses of the crop. Another feature of great importance to the dairyman lies in the stimulus potassic fertilisers give to the growth of clovers in land laid in for hay, and in temporary seeds mixtures. Lastly, the important consideration arises that 75 per cent. of the potash contained in the cow's food passes into the urine and is commonly lost to the farm; it must therefore be replaced. The cow keeper can use sulphate, muriate, kainit or potash salts, whichever appears to be cheapest.

To the potato grower potash is a recognised necessity, and it is already used in quantity for this crop. Wherever much dung and nitrogenous manure is used for the purpose of increasing the yields, it is necessary to balance with potash, otherwise both yield and quantity suffer. The muriate and sulphate give approximately the same crop increases, but the sulphate is the better for quality. Some of the compound manures used by potato growers do not contain sufficient potash; the county organisers should be consulted in cases of doubt.

Need for Organic Matter.—In the early Rothamsted experiment with wheat quoted at the beginning of this article the yield from the mixture of mineral manures and nitrogen compounds—in other words from complete artificial manure—was somewhat greater than from farmyard manure. A similar result was obtained with barley. The success of Lawes and other farmers with artificials led chemists to think that these manures gave the crop everything necessary, and even

to assert that they were better, cheaper, and more certain in their action than farmyard manure. Subsequent experience at Rothamsted and elsewhere has shown that this is not the case. Artificial manures cannot maintain the fertility of arable land as well as dung, and it is evident therefore that dung supplies something to the soil or the crop that artificials do not. Considerable investigation is going on at Rothamsted to find out wherein the difference lies. Already interesting chemical and physiological results have been obtained, and it has been shown that certain chemical substances contained in farmyard manure have a stimulating action on leguminous crops which artificials do not possess. Whether it will be possible to prepare these substances separately and put them on the market as Lawes did with the constituents he studied remains to be seen; the facts are being carefully ascertained and fully studied.

Again, it is well known to farmers that dung has a beneficial effect on the tilth of soil. Measurements at Rothamsted have shown a saving of over 22 per cent. on the power consumption required for ploughing dunged as compared with unmanured soil. Other measurements have shown a gain up to 5 per cent. or even more in moisture content of the soil as the result of dunging—an invaluable help in a dry season. Here again the facts are being studied at Rothamsted and the causes at work are gradually being discovered; until this is done it is impossible to tell the farmer much that he does not already know, or to put the facts in such a way that inventors can use them. Further attempts are being made to increase the supplies of organic manures on the farm by green manuring, the preparation of synthetic manure direct from straw, and in other ways. Finally, close investigation is being made of cases where artificial fertilisers fail to give the expected return, for it must always be remembered that the crop needs other things besides food, and unless these are supplied it cannot make full use of artificial fertilisers.

* * * * *

HAYMAKING.

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Agricultural Organiser for Derbyshire.

ABOUT six million acres of permanent and rotation grassland in England and Wales are annually mown for hay. The hay crop thus occupies about the same total area as all the corn

crops together. In districts with low or moderate rainfall the harvesting of the crop may in most seasons be carried out without great difficulty. In other districts—generally where the acreage to be secured is greatest—the process is subject to great hindrances owing to weather conditions and shortage of labour, so that frequently a high proportion of the nutritive matter grown is lost, the remainder being secured at a great expense per unit.

Feeding Value of Hay.—Hay is not so nutritious as the dry matter of pasture grass. It cannot be regarded merely as pasture grass without water; for whereas pasturage is in itself a complete food and capable of supporting cows in full milk, hay requires to be supplemented with other feeding stuffs which enrich the ration in digestible matter, especially protein. An important difference between the dry substance of pasture grass and that of hay is that while 100 lb. of the former yield 56 lb. of productive nutriment (starch equivalent), 100 lb. of the dry matter of good hay yield only 36 lb., and of poor hay only about 20 lb. A milch cow can extract all the nutriment she requires in a day by consuming about 27 lb. of pasture dry-matter, a quantity well within the capacity of a Shorthorn of average size; but to obtain the same quantity of starch equivalent from good hay, she would have to consume 42 lb. of hay dry-matter. This quantity would exceed her digestive capacity, but even if she could consume and digest that weight, her energy would obviously be diverted from her main function of making milk.

Very good hay tends to approach in character the dry matter of pasture grass, while bad hay has many points of resemblance to straw. As affecting the nutritive value of hay, the principal factors more or less within the farmer's immediate control are the time of cutting and the process of harvesting.

Time of Cutting.—It is established knowledge that leaf is more nutritious than stem and that as a grass plant approaches botanical ripeness the digestibility and productive value of its dry matter diminish. Hay made from ripe grass that has lost its leaf and seed, is merely straw. This knowledge lies at the foundation of the well-known rule as to cutting as soon as the majority of the grasses are in flower. In practice the rule is very commonly applied only in respect of the first field to be mown; the other fields may be ripe, dead ripe or seeded, according to the progress made in harvesting previous fields. Where a considerable acreage has to be dealt with, good

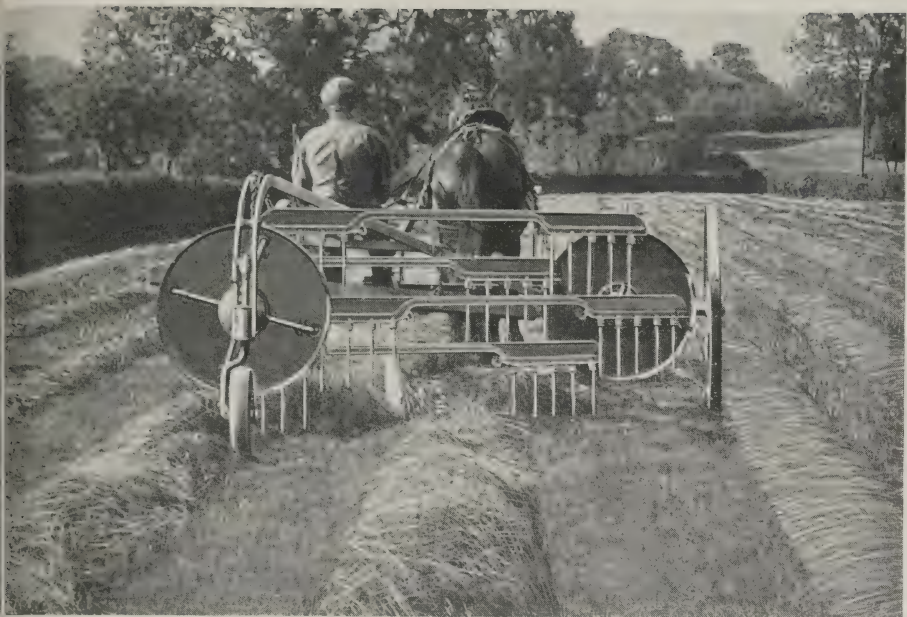


FIG. 1.—Side-Rake adapted for Swath-Turning.

(From "Farm Implements and Machinery," by courtesy of Messrs. Benn Bros., Ltd.)

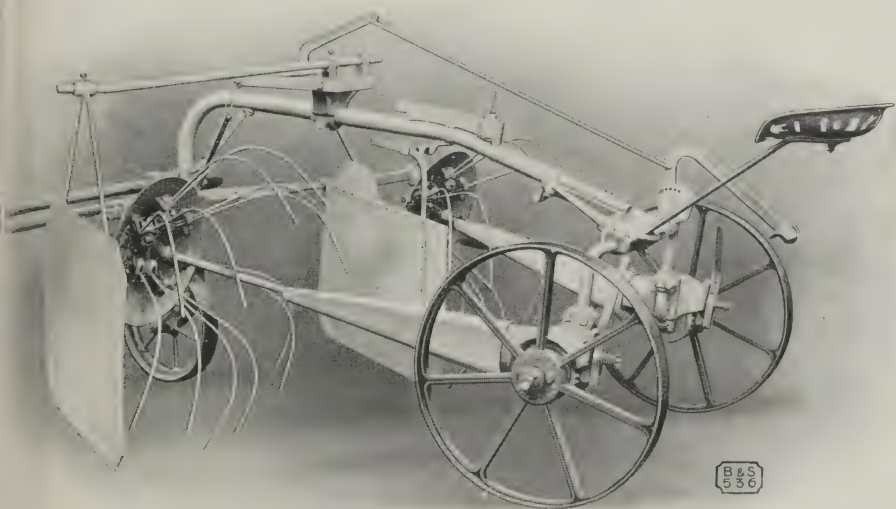


FIG. 2.—Swath-Turner, adaptable for Side-Raking.

(By courtesy of Messrs. Blackstone & Co., Ltd.)

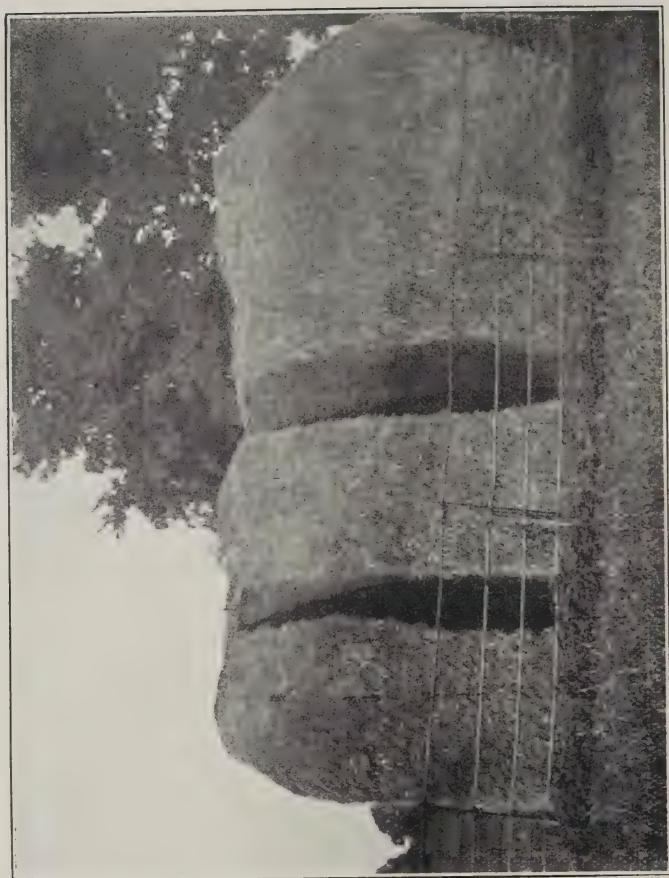


FIG. 3.—Over-heated Stack cut to promote cooling.

weather at the end of June should not be allowed to pass unutilised in the hope of gaining a few cwt. increase in yield per acre. The writer has frequently heard farmers admit the advantage of making an early start; but never has he heard a regret in respect of commencing too soon.

Early mowing involves some loss of weight of produce and a greater loss of bulk, but the additional weight and bulk obtained by later cutting represent matter of little nutritive value. Early-cut grass is also more watery and more fermentable than mature herbage; but it very often happens that there is a spell of fine weather at the end of June, whereas August is often wetter. The loss of nutritive value attributable to over-ripeness and to weathering usually greatly exceeds that due to cutting too early. The early-cut field also throws up a better aftermath, which often comes in for feeding at a very opportune time, and if the practice is continued, it becomes free of certain weeds that usually infest late-cut fields.

It has been proved by feeding trials with dairy cows that hay made by carefully drying short leafy grass has the same nutritive value as fresh grass. Cattle feeders also know that a feeding pasture will fatten stock only while the sward is kept reasonably short; if the herbage is allowed to run up and become stalky, it no longer possesses the nutritive strength necessary for fattening. These two facts emphasise the importance of early mowing and suggest the desirability of experimental work to ascertain whether the increased nutritive value of hay made from two or more cuts of shorter herbage could be secured at an economical cost. In some parts of Europe, particularly Holland, it is common practice to mow the meadows twice or even three times in the year, manuring accordingly. In this country, however, farming opinion is against the mowing of aftermath; that of late-cut meadows would be difficult to harvest; and usually it is needed to help the pastures. As regards the effect on the future condition of the meadow, it is immaterial whether the aftermath be grazed off, or mown off, provided that if mown the land receives a proper return in the form of manure. In one case with which the writer is familiar, the aftermath of over 100 acres of meadow land has been mown every year since about 1890, the produce being made into stack silage with the aid of compression wires.

Economics of Haymaking.—The main object in haymaking is to secure at the least possible cost the greatest possible

amount of the nutriment grown. Were it not necessary to count the cost, then probably air-drying under cover would best attain the object; and with the aid of a current of warm air, good hay could be made in any weather. Similarly, some of the methods ordinarily practised in humid climates result in securing a greater proportion of the nutriment present in the grass crop but at a higher cost than the methods usually applicable in more favoured countries. However, the idea of reducing costs at harvest time must not be carried to the point of omitting to perform operations that are desirable under the conditions prevailing at the time.

The cost of growing, cutting, carrying, stacking and thatching hay, under Midland conditions, is about £3 10s. per ton; to this must be added the cost of the "making" process, which is a variable item, but small in relation to the other costs. In good weather the making may involve only twice swath-turning and side-raking at a cost of about 3s. 6d. per ton. Under certain conditions, however, it is desirable, for instance, to put hay into cock, instead of leaving it overnight abroad or in windrow, and on the next morning to throw the hay out, ted it, and again gather it into windrow. The cost of this additional work is again about 3s. 6d. per ton; but it may prevent the deterioration of the hay to the extent of over £1 per ton, and it may actually involve the least labour and expense in the end. Under other conditions, coiling may be an unnecessary expense and interrupt the work of carrying other hay which is ready to stack.

Principles of Haymaking.—Grass ready for mowing contains 70 to 75 per cent. of water; hay that has completed its "sweat" contains about 15 per cent. Until the proportion of moisture has fallen to the latter figure, the material is subject to fermentation of one kind or another. The principal aim in the process of haymaking is to reduce the moisture content of the grass to about 20 per cent. If at the time of stacking there is still 25 per cent. of water in the hay, rapid fermentation may take place and if the stack is large the temperature may attain a high figure involving considerable loss of digestible matter, if not actual ignition. Several agents play a part in the work of drying out the excess moisture:—(1) the sun; (2) the air; (3) fermentation or "sweating."

Sun Curing.—Light crops may under sunny conditions be "made" by mere exposure of the cut grass to bright sunshine,

The hay after cutting is, if necessary, scattered abroad with a tedding machine to expose the greatest surface to the sun. While sunshine is appreciated as an aid to haymaking, it is possible to injure the product by continuing the sun-curing until the hay is quite dry: the result is a bleached, odourless hay from which the fine and more nutritious parts, having been made brittle, are apt to break away. Clover and lucerne are very readily injured by over exposure to strong sunshine, and accordingly the swaths should not be teded abroad under a bright hot sun, but only turned gently and subsequently collected ready for carting or cocking.

Air Drying.—So long as the atmosphere is not saturated, the cut grass will continue to yield up its moisture, even in the absence of sunshine. The rate of drying depends upon the dryness of the air, its movement (wind), if any, and the surface of grass exposed. The drying power of the atmosphere may be measured with a simple hygrometer: one thermometer has its bulb kept constantly moist, the other bulb being kept dry. When the two thermometers register the same temperature, the air is saturated and it is futile to ted or otherwise move hay in the hope of helping on the drying.

The greatest surface of grass is exposed to the air when it has been scattered abroad; and when the sun is not too strong, this tedding abroad is the best means of accelerating drying on a calm day. It is only when there is sufficient wind that the hay dries more quickly in windrow or loose swath than it does when spread out over the whole cut surface of the field.

The disadvantages of having the hay spread out are that in this condition it is most liable to injury by untimely rain, while if left abroad over night it cools and catches more dew than does hay in row or cock. If cocked while still enclosing warm air, the hay collects little dew; the movement of sap from stem to leaf continues during the night, and drying proceeds the more rapidly when the cock is opened out next day. A well-made cock of meadow hay will turn rain, but rough heaps may be wetted right through to the bottom. Coarse stemmed hay such as clover or lucerne may become soaked through in the cocks, as occurred on many farms in 1923. Some American farmers avoid this danger by using covers for the heaps.*

In Scandinavian countries and in other parts of Europe, air drying is facilitated by "coiling" the half dried grass loosely upon vertical stakes bearing cross pieces, or on a framework.

*See *Covers for Corn Stooks and Hay Cocks*, this *Journal*, July, 1922, p. 378.

such as might be imitated by leaning and fixing together a pair of sheep hurdles in the shape of an A. Another device adopted for the same purpose where timber is less plentiful, is constructed as follows:—7-ft. stakes are driven into the ground in a row, about $1\frac{1}{2}$ -2 yards apart; a rope is stretched from one to the other, hitched on each stake about 20 in. above the ground, and loaded with hay; then the rope is again stretched and hitched from stake to stake 18 in. above the first, and this is similarly loaded; and so on until 3 or 4 layers have been put up.* Hay built on to drying racks is comparatively free from injury by rain or dew, while it continues to dry during the fine intervals. There is comparatively little loss of nutriment in the making of hay by this process; but some discretion is required in the matter of the condition of the grass when put into the rack: no rain or dew must be present and it must be already about half "made." This method is specially good for clover and lucerne hay.

Fermentation or "Sweating."—Most farmers make use of a limited fermentation in the stack to complete the drying of the hay and at the same time to improve its aroma. To ensure satisfactory results the hay must be stacked before the plant cells are quite dead, and the 5 to 10 per cent. excess moisture still present must not be that of rain or dew. Hay is ready to stack when the crop is uniformly dry to such a degree that it rustles in the hand, the leaves have become somewhat brittle, the nodes in the grass stems are shrivelled, and the coarsest stems will crack when doubled over. If the hay is dead—from over-maturity at cutting or protracted harvesting—it must be dried more thoroughly than usual before stacking; otherwise it is liable to become bitter or mouldy, as a result of a "cool" sweat.

The actual degree of dryness necessary for safe stacking depends on the size of the stack. Comparatively "gay" hay containing 40 to 50 per cent. of moisture may be put together in small stacks in the open, if well consolidated; and this fact is widely applied in some countries, including the northern parts of Britain, as a means of economising good haymaking weather.

In some places early stacking in sweat ricks is intentionally adopted for the production of "brown" hay. The process is as follows:—the grass is dried in the usual way until it is about a day short of the condition that would be requisite if it were being put into an ordinary large stack or barn. Usually about three days' air drying are given, clover or lucerne of course

*See *Method of Drying Hay in Sweden*, this *Journal*, Oct., 1907, p. 417

requiring longer than grass; the partially "made" hay, free from dew or rain, is then put together in conical sweat ricks on a bottom about three yards across, the material being put on in layers of about 10 in. thickness and each layer very firmly and uniformly trampled down from the centre outwards. The ricks are built in the field, a bottom of straw being laid down to keep out ground moisture, and the top is raked down and secured with bands. In two or three days the temperature rises appreciably, and about the third week reaches its maximum of 140 to 160 deg. F., the excess moisture meanwhile steaming off. From this point the temperature falls and at the end of the third or fourth week the hay is ready to be put into the barn or the large stack. The product is a slightly browned hay of agreeable aroma and good condition.

The advantages of the above method are (1) that the hay is secured against the weather a day or so sooner, this day often being a critical one; (2) the work of leading home and stacking is deferred until the entire crop has been saved; and (3) the risk of firing or overheating is reduced. As regards labour considerations, it may be mentioned that, by the use of a collector for sweeping the hay together to form the sweat ricks and a hay-bogie or a rick-lifter for carrying home, considerable economy in hand labour can be effected.

Over-heating of Stacks.—Bacteria play an important part in the heating of stacks. The initial rise in temperature is due to the respiratory activity of the still living grass cells, this warmth making conditions favourable to the bacterial fermentation which follows. A certain bulk of hay—about a load—is needed to conserve the heat sufficiently to ensure a warm sweat, and as already stated, the hay must be still alive at the time it is put together.

If the fermentation continues at only 60 to 100 deg. F., which sometimes happens when damp hay lies long in cocks unmoved, the result may be a bitter or mouldy product, these temperatures favouring the growth of the coli bacillus and the mould fungi. The most desirable hay organism—*B. calfactor*—comes into action at 104 deg. F. and is killed by temperatures above 167 deg. F.

When the mass of "gay" hay put together in one rick exceeds about three loads, there is risk of the temperature rising undesirably high, the heat generated not being able to escape fast enough. The charred part of an overheated rick built on the ground occurs below the centre point of the stack; a raised

staddle by permitting the heat to escape downwards, as well as in other directions, is a means of checking overheating. High temperatures involve considerable loss of the soluble constituents of the fodder and a reduction of its digestibility; but in an ordinary large stack or barn there is more serious danger when the heart of the mass continues to rise above 160 deg. F. In this case the fermentation is passing from the biological to the chemical type—the bacteria having been killed. The danger is more imminent when about five weeks after stacking the rick continues to sweat and smell and the size of the mass shrinks unusually. The writer has had some experience of the use of the hay borer, by means of which cores about 5 in. in diameter are cut down into the heart of the stack, forming chimneys for the escape of hot, moist vapour. Such experience has been favourable to the device; but whatever method of cooling a hot stack be adopted, it is desirable that it be put into operation before the temperature in the heart of the rick has reached 170 deg. F.

Losses in Haymaking.—Ordinarily 10 to 20 per cent. of the nutriment present in a crop of grass is lost in the process of converting it into hay, but the loss may exceed 30 per cent. The losses fall partly on the visible portions of the fodder—leaf, fine stems and seeds—but even to a greater extent on the soluble and readily digestible internal constituents. The causes of loss are as follows:—

1. *Respiration.*—The grass does not die immediately after mowing but continues to respire and consume its cell contents. The loss from this cause may amount to over 10 per cent. of the weight of the dry matter of the crop, the greatest losses occurring when, owing to bad weather, the cut grass must lie many days in a moist condition. On this account it is undesirable to mow down a greater area than there is a fair prospect of being able to secure within a week.

2. *Shedding.*—As a rule there should be no seed to shed. The loss of leaf and other fine portions of the fodder is due to over-drying, especially sun-curing, and to rough treatment of the crop. The tedding machine may offend in this particular, for which reason it is considered an unsuitable appliance for the making of clover or lucerne hay, or mixtures containing much clover.

3. *Leaching.*—Untimely rain, falling on half-dried grass spread over a large surface, may remove a large proportion of the sugar and the soluble ash constituents of the fodder. Swathes and windrows, and especially well-made coils, are capable of resisting to some extent the action of rain.

4. *Over-Heating in the Stack.*—Mow burnt hay contains little digestible carbohydrate, and the digestibility of its proteins is very low. Losses up to 20 per cent. of the nutritive value of the hay have been recorded as due to over-heating in the stack.

There are other losses which affect the palatability of the fodder perhaps to a greater extent than its starch equivalent. Over-made hay is not liked by stock, although if there has been no leaching or shedding, the nutrient matters may have been well preserved. Mouldy fodder is almost invariably rejected, unless masked by chaffing and mixing with other foods of an attractive nature. Dew and rain, if present in the hay at the time of cocking or stacking, encourage the development of moulds to a much greater extent than the same amount of moisture in the form of natural cell sap.

Hay-Harvesting Machinery.—Sixty years ago the grass crop was mown with the scythe, and most of the drying operations were carried out by hand labour; the men worked while the horses stood idle until the hay was ready for carrying. One man was needed for every 5 acres to be “got.” Nowadays the area harvested per man is about 15 acres, machinery having increased the output per man by about 200 per cent.

The smallholder who grows and secures his own hay must have a mower, a “haymaker” and at least a slide-rake for rowing: he usually borrows a dump rake for cleaning up. This minimum equipment can be amplified, according to requirements and the area involved, by the addition of a swath-turner, a side-delivery rake, a loader, a sweep, a horse-fork or an elevator, and where the sweat-rick method is adopted, either a hay bogie or a rick lifter. The practical farmer does not, however, buy every machine that he would like to possess or that would be useful to him: unlike the manufacturer, the farmer uses a machine on only a few days in the year, hence the overhead charges on farm equipment are heavy in relation to their services. Some examples of the circumstances which should be considered in selecting hay-harvesting tackle are explained in the following paragraphs.

Haymakers.—Where there are 100 acres of hay to harvest, there is sufficient employment for the three machines—swath-turner, tedder and side-rake. With such an area the ordinary rate of progress is about 6-8 acres per working day: thus while the swath-turner is operating on the grass mown a day or two previously, the tedder is breaking open and tedding the swaths turned the preceding day, and the side-rake is engaged in a third field airing the hay and putting it up in larger rows ready for cocking or carrying. The advantages of this machine over the dump rake are very distinct.

Where the acreage concerned is only half the above and the rate of progress only 3-4 acres per day, one of the three machines could be dispensed with: the tedder is almost indispensable and the side-rake is invaluable. Fortunately there are good machines which combine the functions of swath-turning and side-raking. One type is primarily a swath-turner, and may be preferred for work on uneven land. The other is primarily a side-rake; this may be recommended for level surfaces, while it has a third capacity, viz., tedding.

Loaders and Sweeps.—The loader is most useful where sufficient labour is available to operate mechanical stacking tackle. It renders best service where the haymaking staff comprises more than seven men. If the hay has to be cocked, the loader is not applicable; but in this case the labour of pitching and loading and even that of unloading is appreciably reduced. The sweep rake offers the cheapest and most expeditious means of carrying where the crop is stacked in the field. For similarly clearing small areas, the simple hay collector is invaluable.

Unloaders.—Where the acreage of hay and corn is sufficient to justify the outlay, an elevator is to be recommended. For medium sized farms, however, the horse fork may be a great help, affording relief in the heaviest task—pitching on to the stack—and removing the most common source of delay in the carrying operations.

Conclusion.—For the conduct of farm operations in general and for hay-harvesting in particular, recipes can be of only very limited service—applicable only under certain conditions. It is otherwise with principles, an understanding of which enables the farmer to adapt his methods to his varying circumstances and requirements and to draw more valuable lessons from each season's experience.

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THE PROGRESS OF SCIENCE AND MACHINERY IN HORTICULTURE.

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MODERN commercial horticulture in England may be said to be the growth of the last sixty years or so. From the comparatively simple occupation of old-time nurserymen and gardeners,

it has developed into a highly specialised industry, tuned up to the highest point of efficiency by the tonic of the competition of products drawn from every favoured zone of the earth's surface, and grown by workers in every stage of industrial development from barbarism to high civilisation. No other section of cultivators of the soil has lent so ready an ear to those qualified to express scientific ideas and to explain the processes by which the ideas could be put into practice. No other branch of the parent tree of agriculture presents so attractive a field for the activities of the organiser nor so inviting an atmosphere for experiment.

Cultivation.—In dealing with the soil, machinery has been brought into use for securing the deep tillage which is so essential to intensive cultivation, from the deep scarifier worked by steam tackle to various forms of sub-soilers drawn by horses or tractors.

The tractor is now a familiar machine on intensively cultivated holdings from 50 acres upwards. Preparation of the soil for a crop can, by this means, safely be deferred until weather conditions are favourable for tillage. Small mechanically-driven implements are also much in use among crops and nursery plantations.

Science has been brought into co-operation in the manuring of the soil. On many undertakings, regular analyses are taken and the considered prescription of the scientist applied. The analysis required by law to be given with every sale of manure is becoming better understood, and growers are becoming increasingly familiar with purchase by unit value.

The use of soil sterilisers, both chemical and mechanical, the latter by steam heat and dry heat, is common practice in the glasshouse industry. In the open, soil fumigants are increasingly used in the culture of root crops.

Plant Breeding.—The laws of hybridization have been closely studied and put into practice, to the great improvement of types and increase of varieties. From the aristocratic orchid to plants that a quarter of a century ago were only considered as weeds, the careful and sympathetic attention of the horticulturist has developed varieties and combinations that our grandfathers would have deemed to be beyond the bounds of imagination.

Much has been done in the breeding of improved types of vegetables and fruits. It is significant that the first oranges to be planted in Florida were bred in an English nursery. Many of our favourite vegetables are introductions from warmer climes;

the development of types that will be happier in our climate is proceeding, though much ground remains to be covered.

The problem of supplying the home grower with varieties of apples to compete, in attractiveness and in the habit of consistent good cropping, with some well-known kinds from overseas, is not yet solved, but in our first-class nurseries and in research stations there are batches of seedlings, the product of scientific crossings, from among which any day there may appear the desired combination.

The cucumber has been developed both in prolificacy and shape of fruit, and also in ability to resist disease, so that the produce comes upon the market with almost the regularity of the product of a factory, and the English cucumber dominates the trade in many parts of the continent of Europe.

The tomato has been developed from the unattractive corrugated fruit, to the present even-sized, round fruit grown on a plant of high productive capacity. Twenty-five years ago the tomato was an object of curiosity; to-day it is a staple article of diet.

Similar developments have taken place with grapes and other hothouse crops. Important developments are also on the way in the case of black currants and plums.

Heating.—Perhaps in no department of horticultural activities has there been more application of science and machinery than in the nurture of the various crops. The protection against the austerities and vagaries of our climate afforded by a glass roof has been persistently developed. From the erection of thirty years ago, which was more wood than glass, to the present-day greenhouse—with its fine adjustment of dimensions to the amount of atmospheric movement desired, its thin, yet strong, bars placed wide apart, and its large panes of clear glass and small lap—there is all the difference between the primitive and the complete. Glasshouse installations with from ten to twenty acres completely covered with glass are now common, while if one adds the area occupied by movable frames and other temporary forms of covering there are installations with a hundred acres or more under cover.

In the matter of heating, too, the horticulturist owes much to co-operation with the scientific engineer. The boilers of to-day give much increased heating from a given amount of fuel, while electric impulsers accelerate the flow of water to pipes of more than one diameter and to differences in level; while heating by high-pressure steam has received its attention and has its advocates.

Plant Diseases and Pests.—In intensive cultivation there is more opportunity afforded to the attacks of plant diseases and pests, and a greater field for their rapid multiplication than in the more extensive forms of cultivation, and here the preparations of the chemist and the use of machinery for their application have been remarkable in their development. By means of spraying with toxic preparations both dry and liquid, and by means of fumigation with cyanide, nicotine and other preparations, fairly complete control may be established over many plant diseases, the uncontrolled spread of which would make the cultivation of certain crops economically impossible. The provision of machinery for these various applications has afforded a fine field for the inventor. The opportunity has been so well exploited that the grower, whatever the size of his undertaking, however varied his requirements, can have a choice of appliances; whether it is the production of a fine mist spray for liquids, or the dusting of powder; whether by manual, horse or motor power.

The installation of permanent power plants in orchards and in undertakings for intensive cultivation enables the grower to make the fullest use of the discoveries of the chemist. The use of electric power and light for promoting growth in greenhouses has received attention, but is not yet beyond the experimental stage.

Fruit Stocks.—Investigations into the root formation of the stocks used for budding and grafting have been carried out at East Malling and Long Ashton, and the results have been applied extensively in fruit plantations. The cultivation of apples and pears upon dwarfing stocks enables the scheme of plantations to be either of cordons or of dwarfs as fillers, with standards or half-standards as the ultimate character of the plantation, and has reduced the waiting time for economic returns from a fruit plantation to from three to five years instead of from six to ten years.

Grading and Packing.—The intensive cultivator has not only availed himself of the assistance of science and machinery in the production of his crop, but has also advanced in the no less important department of marketing. The tomato and cucumber growers in this country first realised the meaning of the attention given to grading and packing by exporters from overseas, and what preparation to attract the eye of the purchaser meant to the home producer. More than fifteen years ago the cucumbers and tomatoes grown in the Lea Valley and at Worthing were

standardised both as regards grading and packing, and the standards then fixed for these products have now become general.

The movement in favour of scientific grading and packing is now in full swing and promises within a short time to cover the whole field of horticultural production. Machines for grading tomatoes are already being used commercially. Various types of grading machines for apples are on the market and many are in actual operation, while plans are maturing for the establishment of a co-operative grading and packing station for apples in East Anglia.

In the matter of transport full advantage has been taken of modern developments, and tons of produce that formerly had to undergo the double handling necessitated by railway transport are now taken to various markets by motor lorries owned either by growers or by salesmen, within a radius of 50 miles from the market: while the railway companies, by the introduction of more scientific methods for the handling of perishable produce, are steadily lessening the damage factor incident to long distance transport.

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THE STUDY AND TEACHING OF AGRICULTURAL ECONOMICS.

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IN some countries it has long been recognised that in the general study of economic phenomena insufficient attention has been paid to the economics of agriculture, and that the results of the general studies of economic organisation cannot be applied to agricultural conditions. Amongst the countries which have recognised this fact may be mentioned the United States of America, Switzerland and Denmark, for in all these countries a highly developed organisation for research in agricultural economics now exists; and in the United States the teaching of agricultural economics has reached an advanced stage. In most of the universities facilities are provided for taking subjects in agricultural economics in degree courses leading to agricultural or to social science degrees, and in several of the most important of the universities post-graduate degrees are awarded for work in either agricultural economics or rural sociology, or in a combination of these subjects. Amongst these may be mentioned Cornell and Wisconsin Universities. Moreover, the study and teaching of agricultural economics and of rural social science has

had a profound effect on the teaching of both agriculture and social science in the whole of the United States, and is now exercising a considerable influence on public policy in regard to problems of land, agriculture, and rural social organisation.

Institutions Teaching Agricultural Economics.—In England the first facilities for study of agricultural economics were provided in 1913 when the Institute for Research in Agricultural Economics was established at Oxford by the University and the Ministry of Agriculture supported by the Development Commissioners. During the war, special developments of study, particularly the study of the costs of production of farm produce, occurred, but these disappeared in 1920. During the last year provisions for the study of the *business management of farms* were made by the Ministry of Agriculture in connection with colleges and universities. Economic Advisory Officers, who will study the systems of farm management in their respective areas and take part in teaching principles of economic farm management in their institutions, were appointed at Oxford University; Cambridge University; Leeds University; University College, Reading; and Wye College, Kent. Minor provisions for the study of special problems of farm management have also been made at other institutions.

Before these later provisions for the study of agricultural economics were made several colleges or universities had made a practice of providing some teaching in economics for students in agricultural degree courses. This teaching was chiefly limited to economic history and general economic theory, for organised knowledge was too scarce to admit of the teaching of agricultural economics *per se*. Amongst institutions providing teaching of this character may be mentioned the University College of Wales, Aberystwyth; Leeds University Agricultural Department; School of Rural Economy, Oxford; School of Agriculture, Cambridge; and Wye College, Kent. The School of Rural Economy, Oxford, included in subjects required for the Pass Degree those of Economic History of Agriculture, Economic Theory, Costs of Production and Marketing of Farm Products, Estate Management, Local Government and Administration. Amongst some of these subjects the students could choose, but they were required to take some economic subjects. Henceforth, it appears certain, students for degrees in agriculture in all universities will be required to take certain economic or social subjects of study, and the tendency will be to develop these departments of research and teaching.

Although progress is being made in teaching agricultural economics or rural social science subjects to students of agriculture, no advance in the opposite direction—of teaching agricultural economics or rural social science subjects to students of general economics or the social sciences—has anywhere been made. Yet there is sufficient divergence between economic and social phenomena in agriculture and rural life, and such phenomena in other industries and in urban environments, to justify their special study and also a special branch of teaching. Indeed, the time has now arrived when one or more universities could safely make provision for special study and teaching of agricultural or rural economics and of rural social science leading to an Honours or to a Post-Graduate Degree. Such a course should be open, and would have appeal, to students who have taken a Pass Degree in Agriculture, for which the course had included a preliminary study of economics, or to students having taken a general agricultural course and who wished to specialise; also to students who had taken a general course in economics and social science and wished to specialise in the rural aspects of these sciences.

Two Fields of Study.—The general scope of the study and teaching of agricultural economics covers two more or less distinct fields, viz., (a) the factors in the internal management of the farm which determine the productivity of the enterprise and the remuneration of those who are engaged in it, whether workers, farmers or landowners; and (b) the external factors which determine the course of production which is possible or desirable, and those which determine the prices of farm products. In other words, the two fields are those of the Economics of Farm Management and the Social Economics of Agriculture. Conditions of organisation, remuneration and life on English farms are determined not only by the conditions on the farms themselves, but also by forces which arise in other industries or within the agricultural industry of other countries. Therefore, it is not sufficient to study the economic phenomena of farming organisation apart from general economic and social phenomena connected with the industry over a wide geographical area.

Indeed, the scope and methods of study which past study and teaching of agricultural economics have shown to be necessary may be stated in this way:—

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| (1) Economics of Farm Management | $\left\{ \begin{array}{l} (a) \text{ Accounting method.} \\ (b) \text{ Statistical method.} \\ (c) \text{ Survey method.} \\ (d) \text{ Experiment.} \end{array} \right.$ |
| (2) Social Economics of Agriculture | |
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| | |

Farm Management.—The study of farm management includes amongst other things the study of costs of production of crops and live stock, and the factors which lead to high or low costs, whether technical or social. It also includes the results in profits and/or wages of organising types of cultivation or animal husbandry on a large or small scale; the results in gross and net production of large and small-scale organisation; and the social results, such as the effect on the family of different forms of organisation.

The most important results which the study of farm management, especially by accounting and statistical methods, has yielded, and is still yielding, are those showing the requirements in labour, food or materials for various processes. In such matters as the labour requirements per crop-acre, or dairy cow, in man-days and horse-days per acre or year, the study has yielded such results as will soon make it possible to state extreme variations and their causes, together with the average or standard requirements. The establishment of standards of this character will be of immense value to farmers, especially such as are developing experience, in that they provide criteria for the results of their own management.

Again, when results have been collected under sufficiently varying economic conditions and over sufficient geographical area, it will be possible to do some reliable cost estimating for guidance in making contracts which apply to goods to be produced in the future, as in the case of milk. Studies have shown remarkable constancy in certain proportions of costs due to various items, and when the price of items in cost, *e.g.*, labour or food, can be forecast, fairly reliable estimates of total costs can be made. It is, however, in the establishment of standards of requirements that accounting in particular holds out great hopes of practical assistance in internal farm management.

In its human aspects the study of farm management itself verges on the study of the social economics of agriculture and rural life. But the study of internal management also verges on the study of geographical or social phenomena in other countries, especially in relation to the systems and costs of market-

ing farm products, and the prices of such products in the home market. The social economics of the industry include all subjects which would be included in a general study of the social economics of all industries. But it may be said that the study of the social influences affecting the organisation of farming is of practical and financial, as well as of cultural, value. In a study of British farming, knowledge of the recent history of agricultural development in other countries, notably in the United States, the self-governing Dominions, and in the countries of northern Europe is of both cultural and practical value. Similarly, in the study of development of types and methods of English farming, knowledge of geographical influences in other countries as well as in this country is of cultural and practical value.

Methods of Study of the Economics of Farm Management.—As regards the economics of farm management *the accountancy method* has been used to discover principles and details of economical production of crops and stock. It can also be used to discover principles and details of division of income within the industry.

The statistical method is used for the same purposes when less accurate detail is required, or when information is required over a greater area or a greater period of time than can be covered by accountancy.

The survey method is also used when complex influences have to be studied in relation to internal conditions on farms, and when large areas have to be covered. It is particularly useful when geographical or social influences have to be correlated with farming conditions.

By *experiment* is meant trial of methods under controlled conditions, and although this has scarcely yet been used in this country it has been used in other countries, and may be used here when sufficient knowledge has been obtained to make possible isolation of factors and definite trial of limited methods.

Methods of Study of the Social Economics of Agriculture.—As regards the social economics of agriculture, *the methods of geography* are important in the study of distribution of types of crop or animal husbandry in relation to soils, climate, contours, transport and markets.

The historical method applied to any period is useful for cultural purposes, but for practical purposes its application is chiefly to the last 170 years of agricultural development in Europe and the European settlements in other continents. In relation

to the development of the science and practice of agriculture, it yields valuable results for the guidance of the farmer and the executive or administrative official.

The statistical method is applied in the study of the social economics of agriculture as in other social sciences, but there is still a vast field for the practical application of statistical methods to the study of economic phenomena in agriculture, especially in the relationship of the agricultural systems of exporting countries to those of countries like our own.

The survey method is being applied with a large measure of success to obtaining information partly geographical, partly technical and partly social in character. It is yielding information at once valuable to the farmer and to the constructive social engineer.

Economic Farm Management.—The branch of the general study which is most advanced in this country is that of economic farm management. Even in this sphere the study of systems and costs of marketing has made little advance. In this subject persons primarily interested in transport and commerce have large interests, and in many cases would welcome development of facilities for study and teaching. For the study of the social economics of the industry no university or institution has yet made adequate provision. The Ministry of Agriculture has stimulated, and will continue to stimulate, the study of internal economic management of farms, but it is necessary that an academic institution should stimulate the study of the wider aspects of the subjects. One aspect which would immediately repay study is that of marketing, or agricultural commerce.

Openings for Students.—As interest in the general subject of the economics of agriculture is rapidly developing, and the value of knowledge of economic phenomena is becoming recognised, it is practically certain that students of these subjects will find openings for careers. Indeed, in the United States of America, where the study and teaching of agricultural economics has had a great influence on farming policies and on agricultural social policies, the demand for men trained in this sphere has been equal, if not more than equal, to the supply. In this country it is becoming recognised that men required for administrative posts connected with agriculture and rural life should receive an economic and social training definitely related to their sphere of activities rather than a purely technical training in agriculture.

Rural Sociology.—A subject closely related to agricultural economics is that of rural sociology, or the study of social phenomena in the rural environment. No attention has yet been paid to this study by any academic institution in this country, although, again, the study has advanced to a definite position in several American Universities. Such work as has been done in this country has been personally and privately undertaken. Many persons may doubt whether the development of special facilities for study or teaching in rural social science is either necessary or desirable, but there can be no doubt that in this predominantly industrial and urban country the study of social phenomena tends to be limited to the study of such in an urban environment. Nor could it be doubted that the study of rural social phenomena now needs a special stimulus.

A university which now has no very close agricultural connections, but which has close connections with industry and commerce, could make for itself a special sphere in the development of the study and teaching of the social sciences related to agriculture and rural life. The welfare of persons in other industries and commerce is closely connected with conditions of agriculture, not only in this country, but in those countries with which they trade. Some studies of agricultural economics would be of practical value to them, in addition to adding to their knowledge and appreciation of general economic and social phenomena. The study of the economics of the industry, moreover, cannot be carried on without technical knowledge of processes in the production of crops and live stock, but approach from the economic and social side enables the non-agriculturists more quickly to appreciate the importance of ruling conditions in the industry. In addition, the teaching of agriculture itself in this country is taking a decidedly economic trend. The present practice tends more and more to inductive studies of farm management, and of varying practices of crop and animal husbandry as a basis for agricultural teaching. Agricultural economics now provides a practical link between the study of social and other sciences. It also provides a link between the farming and the industrial or commercial communities. It is a subject which can be linked up with existing studies in universities in which social studies are carried on, but in which there is no special study of agriculture. The methods used in the study of agricultural economics are such as provide a wide training and discipline in general scientific methods, and the scope of the subject is sufficient to include matter of both practical and cultural values.

THE GROWING OF FIELD PEAS FOR STOCK FEEDING.

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THE field pea as a corn crop is principally grown in the Eastern Counties of England—Lincolnshire, Suffolk, Yorkshire and Essex showing the largest acreage. The area under peas grown for corn has dropped since the war from 132,249 acres in 1919 to 94,970 acres in 1923. This area includes both peas grown for stock feeding purposes, and blue or marrowfat peas, the grain of which is hand-picked, put up in cardboard packages, and used mainly as a table vegetable and for soup.

Varieties.—The most important variety of blue peas is *Harrison's Glory*. This variety is grown chiefly for packing, but in times of good demand is often marketed in the pod like garden peas. If, owing to bad harvest conditions, insect attack* or other cause, the grain is of inferior quality, or if the price is low, they may have to be used for stock-feeding. *Harrison's Glory* is hardier than most garden peas, but not so hardy as the usual stock-feeding varieties. Of the latter the following may be mentioned :—

Early Minter or Norfolk Dun.—Straw medium length, pods fairly long, grain a pure dun colour. Ripens very early and so usually suffers less than others from aphides or plant lice. Seedsmen offer strains selected for special earliness, longer pods and suitability for autumn sowing.

Maple or Partridge.—Straw long, pods numerous, grain light brown, blotched irregularly with whitish yellow, ripens late. Sometimes in considerable demand as food for pigeons. Maple peas, like all long-strawed varieties, are useful for smothering rubbish, but, on the other hand, are not usually fit to cart until wheat harvest. This precludes the chance offered by earlier peas, of ploughing and cleaning the land before harvest. Maple peas resist attack by aphides fairly well, but the variety is regarded by some as rather a light cropper, especially in a wet season, when it runs to straw.

Black-eyed Susan.—Straw long, grain large and dun-coloured, with black eyes. Ripens in mid-season and consequently is more exposed to aphides than the early dun. Usually considered a heavy cropper.

Eights and Nines.—Straw fairly long, pods long, grain tightly packed in pods, greenish. Ripens fairly early. Is considered by some growers a very valuable variety.

* Regarding insect attacks the following leaflets should be consulted :—No. 19, Pea Weevil (*Sitones*) ; No. 150, Pea Beetle (*Bruchus*) ; No. 48, Pea Thrips (*Frankliniella*).

Other varieties which may be mentioned are *Prussian Blue*—a small blue pea grown for feeding, and *Wisconsin Blue*—a variety introduced from America. A white field pea is also sometimes grown. Distinct varieties have been introduced by the Swedish Plant Breeding Station, but they have not yet been fully tried in England.

Variety Trials.—Very few trials to test the relative yielding capacity of different varieties of field peas have been conducted in this country.

In a test conducted some years ago, in Suffolk, practically identical yields were given by Black-eyed Susan, Norfolk Early Dun or Minter, and Swedish Solo. The year of the test, however, was not a good pea year.

In a test conducted some years ago, in Suffolk, practically ducted, also in Suffolk, in which Hazel Dun—a selection of Black-eyed Susan—gave 200 stones of grain per acre, whilst the three varieties, Maple, a selected Early Norfolk or Minter, and another selected Dun pea, all gave about the same yield—170 stones per acre. Two Swedish varieties gave smaller yields. Too much reliance must not be placed upon the results of a single experiment, but these figures confirm the general view that Black-eyed Susan is a heavy-yielding pea.

Climate.—The best conditions seem to be a spring and early summer in which the weather is neither hot nor cold. A heavy rainfall, except on light land, is not desirable. In East Anglia in 1922 the extremely hot weather in May or June was probably responsible for an insect (aphid) attack which practically ruined the crop.

Soil.—Peas are generally and probably rightly supposed to do best on a good light loam well supplied with lime. Still they may be grown with success on a wide variety of soils. For instance, in dry districts they will thrive on extremely stiff clays, if these are well drained. Not only should such heavy land be under-drained with pipes or moles, but the furrows should be kept scoured and water furrows provided to the nearest ditch. Peas, like most other farm crops, find bad drainage fatal in a wet season. On undrained wet and heavy land a wet May or June will make them go yellow and ruin the crop.

On heavy land, if well drained, however, field peas are much less likely to go yellow and perish with wet than the more delicate marrow-fat and table peas.

Place in Rotation.—Peas usually follow a white straw crop, taking the place of beans or clover. Thus, in the Norfolk four-

course rotation the cropping would be (1) roots, (2) barley or oats, (3) beans, peas, or clover, (4) wheat. Thus peas or beans would come on the same land once in eight years.

This rotation may, of course, be modified in various ways, but it is probably safest and best not to grow peas on the same land oftener than once in six to eight years. If grown oftener, there is greater risk of failure.

Peas, like all other leguminous crops, are able to assimilate the free nitrogen of the air and store it up in their roots, stems and leaves. For this reason they tend to enrich the soil in nitrogen, and a good crop is regarded as a useful preparation for wheat, barley or oats. The amount of vegetable residue left in the soil by a good crop of peas is, however, in all probability not so great as that left by a good crop of beans or clover, hence the land after a crop of peas is not usually in quite such a high state of fertility as after beans or clover.

Peas have, on an Essex farm, been grown successfully after clover. The clover stubbles, after providing a considerable amount of winter grazing, can be ploughed in winter in plenty of time for the peas. It is claimed that two leguminous crops in succession have more effect than a single leguminous crop in enriching the land for the wheat which follows; also that peas succeed better after clover than after a white straw crop. This method may be justified when peas of a valuable kind, such as Harrison's Glory or table peas, are grown, but with ordinary field peas it is better to follow the usual rotation. The method of taking peas after clover may be of extra benefit to one field; the usual method spreads the effect of the leguminous crops over a double area.

Field peas, in many of the drier districts, were found, especially on heavy land, to be one of the best, if not *the* best crop to grow on the grassland ploughed up in the war years of 1917-18. The land was simply ploughed up in winter and allowed to weather, and the peas drilled as early as possible in the spring. Very few failures of the pea crop, even on poor soil, were recorded on land thus treated. When ploughing up grassland it is important to use a skim coulter in order to bury all grass thoroughly, and, in spring, to roll well with a heavy roller before drilling, so as to leave no hollow spaces below the inverted turf. The soil should be repeatedly harrowed with not too heavy harrows, so as to work up the surface to a kindly tilth without bringing up to the turf. Disc harrows are very useful for this purpose.

Time of Sowing.—Peas for stock feeding are usually sown in spring, in early districts as soon as possible after the 1st of January, February being perhaps, the commonest month. While it is an advantage to sow peas as early as soil and weather conditions allow, they may, if the land is too wet for early sowing, be sown successfully in the north and midlands as late as April or even the first week in May, but in East Anglia, owing to the frequent droughts in April and May, such late sowing is very risky. In recent years, autumn sowing, preferably in November, has been found successful. The risk of frost is balanced by the fact that the peas are earlier than when sown in the spring, and hence better able to resist insect attacks in May and June.

Manuring.—Only a few experiments have been conducted in this country on the manuring of field peas. Farmyard manure is occasionally used. Often no manure at all is used and this, on really good soil in a high state of fertility, is probably the safest proceeding; over-manuring of any kind, especially with farmyard manure, tends to produce straw at the expense of pods, particularly with the long-strawed varieties.

On most ordinary soils, however, an application of manure will be desirable, especially when peas are grown after a cereal. As previously mentioned, peas, like other leguminous crops, are able to obtain their nitrogen from the air, and there seems very little doubt that in most cases an application of nitrogenous manure is unnecessary.

The few field experiments of which the results are available indicate the value of phosphates and potash.

At Saxmundham Experimental Station in Suffolk on heavy clay land, peas and beans mixed were grown on a piece of old grassland ploughed up during the war. The mixed crop was the first crop obtained after the grass. Part of the field had received a dressing of 10 cwt. per acre of basic slag of high grade and solubility applied to the grass in 1904 and again in 1912, whilst the other part had received nothing. The crop of mixed beans and peas obtained in 1919 on the slagged part was 40 bushels per acre and 62 cwt. of straw, whilst the unmanured part gave 29.7 bushels of mixed beans and peas and 42 cwt. of straw.

At Bramford Experimental Station in Suffolk peas were grown in 1905 and 1906. The soil was poor and light, but exceptionally rich in available phosphates. None of the manures had a very striking effect upon the crop, but on an average of two years 1 cwt. of muriate of potash used alone gave an increase

of 3 bushels of grain and 2 cwt. of straw over no manure, whilst it also gave a similar increase when added to nitrate of soda and superphosphate.

In pea growing districts an application of phosphates, and, on light soil, of potash also, is becoming increasingly common.

The following are suggested dressings for land in an average state of fertility :—

- (1) Land poor in lime should receive a dressing either of lime, chalk or limestone, or other form of carbonate of lime, a considerable time before sowing the peas.* It is practically useless to sow peas on land seriously deficient in lime.
- (2) On Heavy Land—6 cwt. 30 per cent. basic slag, 4 cwt. 30 per cent. superphosphate per acre, or equivalent quantities of other phosphatic manures.† Basic slag is to be preferred on heavy land poor in lime.
- (3) On Light Land—2 cwt. 30 per cent. superphosphate and $\frac{3}{4}$ to 1 cwt. muriate of potash,‡ or its equivalent of other potash manure per acre. On light land poor in lime, 2 cwt. basic superphosphate or 1 to $1\frac{1}{2}$ cwt. steamed bone flour per acre should be used instead of superphosphate.

Manures such as superphosphate, steamed bone flour, and muriate or sulphate of potash should be applied a few days before drilling, before the land is harrowed down.

Basic slag or low grade potash salts such as kainit should be applied to the ploughed ground several weeks before the crop is sown.

Cultivation.—When growing peas after another arable crop the cultivation is very simple. Provided the land is clean, one ploughing is usually sufficient, especially on heavy land. On light land, or if rubbish is present, a second ploughing may be given. It is important, especially on heavy land, that the final ploughing should be finished before Christmas in order to allow the land to be weathered by the winter frost and rains so that a good, kindly seed-bed may be obtained at the time of planting. It is also probable that peas succeed better on a stale furrow, *i.e.*, on land that has been ploughed and allowed to lie some time before drilling the peas.

As soon as the land is dry enough in early spring—if possible in January or February—the land is worked down by harrows in the same way as for other spring corn, and the seed is

* See Leaflets Nos. 170 (*The Use of Lime in Agriculture*) and 385 (*Lime and its Uses on the Land*).

† See Leaflets Nos. 267 (*Basic Slag*) and 394 (*Phosphatic Fertilisers*).

‡ See Leaflet No. 335 (*Potash Fertilisers*).

NOTE.—Farmers should apply for advice on any point to their County Agricultural Organiser. See Leaflet No. 279 (*Technical Advice for Farmers*).

drilled at the rate of $2\frac{1}{2}$ to 4 bushels per acre, the quantity varying in different districts. The distance between the rows also varies in different districts, but 9 in. to 12 in. is a useful distance. Where the land is not very clean, the wider distance is often used, as it permits of more thorough horse-hoeing. Probably 9 in. is an average width.

Many growers advocate harrowing to destroy seedling weeds as soon as the peas are up through the ground and the land is dry enough. The harrowing of peas, however, requires discretion or the crop may be damaged. When 2 in. or 3 in. high they are horse-hoed once or twice, and hand-hoed. Certain types of horse hoes have very light harrows following the tynes of the horse hoe. These serve to kill small seedling weeds and also to remove soil cast up by the horse-hoe tynes that has covered up the peas. Any docks present should be removed when the land is soft and before they run to seed, a docking iron being used to assist in pulling up the roots.* If the docks are forward enough to be seen they are better removed before horse-hoeing, as that operation cuts off the tops of the docks and leaves the roots to shoot up again.

Peas are rarely successful in a struggle with weeds, and should never be planted on foul land. Further, every care should be taken, while the crop is young, to keep it clean by the methods above described. The straw, at a comparatively early stage, becomes entwined (or as it is called "joins hands"), and when once this has occurred it is impossible to carry out any further weeding owing to the damage that would be caused by walking, however carefully, through the crop.

Later in the season, towards harvest time, peas lie flat down on the ground, and this allows various weeds such as thistles, goosefoot, etc., full access to light and air: hence, unless the land is fairly clean to start with, it is apt to become very weedy before the crop is harvested.

Harvesting.—When sown early and when the variety grown is an early one, peas are one of the first crops to ripen, and they may often be safely in the stack before the other corn is fit to cut.

As a general rule they are cut and made up by hand, either with a pea-hook, or with a scythe. The pea-hook or pea "make," which resembles a sickle, but has only a slight curve in it, is on the end of a shaft, and in the hands of a skilful man does good work. Opinions differ amongst practical men as to which tool, the pea-hook or the scythe, is more satisfactory for

* See Leaflet No. 251 (*Common Weeds*).

cutting peas. Whether hook or scythe is used, the peas are made up into wads or small heaps at the time of cutting.

Field peas are often also cut with an ordinary grass mower or clipper, to which have been attached "lifters" or pea guards similar to those used for laid corn. These lift up the peas in front of the knives, and prevent the pods from being cut off. When peas are cut in this way it is necessary to have the cut peas removed outwards before the machine comes round again. The work of removal is facilitated if a reaper attachment is fixed to the grass mower so that the peas are left behind the machine in small heaps like sheaves. Some large growers use a pea-harvesting attachment which is fixed behind the cutter bar of the grass mower. This causes the freshly cut peas to slide on one side in such a way that room is left for the horses and grass mower to pass by when next they come round, and the removal of the peas by hand is unnecessary.

Mr. A. M. Rope, of Leiston, who grows about 60 acres of peas every year, has used this attachment very successfully for the past 3 years. He fixes it to an old grass mower, pea lifters being also fixed in front of the cutter bar. An old mower is used, as the work is rough and would soon render a new one unfit for grass cutting. Mr. Rope finds the attachment works well if the crop is quite ripe and dry and the land solid—a man and a pair of horses will cut 7 acres a day and do good and clean work. This attachment is especially useful where a large area of peas is grown as under such circumstances the labour available may not be sufficient to take up the whole crop by hand.

Occasionally the implement known as the hay "toppler" is used in harvesting peas. Only half a breadth is taken at once, the horse walking quite close to the unpulled peas. The peas are broken off against the roots by the toppler. Some farmers speak highly of this method of harvesting peas, and there is no doubt that satisfactory work may be done if all the peas lie one way.

Peas are often harvested with an ordinary horse rake, which must be of strong construction. The horse walks just outside the edge of the peas, with one wheel and nearly half the rake running on the peas. When half the rake is nearly full it is lifted up and the peas removed out of the way with a pea-hook or "make." The horse afterwards returns up the same side of the field—half the rake running on the peas as before and pulling up another lot, the other half raking over the strip previously pulled. With the straw dead ripe and fairly long a good job

is made, though there is always a certain amount of waste. With valuable peas the slower method of hand harvesting by skilful workers is probably the most satisfactory method.

After the peas have been pulled or cut two or three days they require turning. This is done with the ordinary hay fork. Turning is repeated every second day or so until both the grain and the straw of the peas is dry, when the crop is carted. If the weather is showery it is necessary to turn the peas very frequently, or the pods near the ground open and the grain is lost. In a wet harvest it is impossible to prevent a good deal of loss taking place owing to the peas shelling in this way. If, owing to prolonged wet weather the farmer is compelled to cut in spite of rain, it is desirable to make small bundles or wads, and to turn after every storm or day's rain, as soon as the wads are dry on the top. This keeps the wet pods from the soil as much as possible. The more the peas are turned the longer the pods remain sealed.

Stacking.—Peas are often placed in rather large stacks. There can be no doubt, however, that, in a wet harvest, they might be carted rather more quickly if the stacks were made narrower. The plan of placing faggots through the stack to act as a ventilation shaft is an excellent one.* Immediately the stack has been built, it should be temporarily covered with a stack cloth, or with " battens " or bundles of straw such as are used in the midlands. Thatching may be performed in a few days—as soon as the roof has settled a little. If a newly-built pea stack is left unprotected for even a single night, and heavy rain falls, great damage may ensue, as owing to the open nature of the peas practically all the rain falling on the roof will penetrate.

Thrashing.—Thrashing is performed in the same way as with cereals, but some slight alterations are necessary. A couple of hurdles are generally reared up over the feeding drum and covered with a stack sheet, forming a tent with one end left open. The concave of the machine is thrown back or made wider, thus avoiding the splitting of the peas. The feeding is generally done with a fork, and the sheet prevents the peas being scattered. If peas are very dry it is sometimes necessary to remove a beater or two from the drum, but as a rule the methods suggested above are sufficient.

* The Ministry in 1923 carried out some successful trials in the artificial drying of pea stacks. See *Artificial Drying of Crops* in this *Journal*, March, 1924, p. 1128.

Value of Straw.—Well harvested pea straw is very valuable fodder, and is much relished by all kinds of cattle, but for some reason it does not suit horses, causing discoloration of the urine, and is seldom, if ever, used for them. If much damaged by the weather pea straw may be almost worthless except for litter.

Mixing of Peas and Beans.—In some districts it is customary to grow a crop known as “blendings,” *i.e.*, a mixture of peas and beans. A suitable mixture has an advantage over either crop alone in that it tends to keep weeds in check, as the beans hold the peas up, and make a smothering crop. One of the great disadvantages of peas grown alone, especially of short-strawed varieties of peas, is that they tend to encourage rubbish.

The mixture of peas and spring beans is also less liable to fail than either crop grown separately, whilst, if a suitable mixture is made, it, unlike peas alone, may be cut with the binder. On the other hand, owing to the dense nature of the crop, sun and air cannot gain access to the flowers so well, so that in some seasons the mixed crop may fail to produce so many or such large pods as is desirable.

For growing mixed with spring beans a fairly late variety of peas, such as either Maple or Black-eyed Susan, should be selected. A mixture found very successful at Saxmundham Experimental Station was 2 bushels of spring beans, and $\frac{3}{4}$ bushel of Maple peas per acre. This produced, as previously mentioned, an enormous bulk of straw, 62 cwt. per acre on one plot, and 40 bushels of corn. The crop was cut with the binder. It sometimes happens that winter beans are found in springtime to be thin; where this is the case they may be horse-hoed and an early variety of peas drilled in. The early peas usually ripen with the beans, and the whole makes a smother crop to keep down weeds.

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IMPROVEMENT OF GRASSLAND IN YORKSHIRE.

II.

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The Use of Phosphates.—There are in Yorkshire, as in most other counties, large areas of poor grassland which have had no previous preparation, such as that discussed in the May issue of this *Journal*, but which give remarkable improvements when adequate supplies of a suitable phosphatic manure are applied.

It is not difficult to recognise such areas of grassland. They occur chiefly on soils with comparatively low lime-requirements (small deficiencies of lime), such as the Boulder Clays of the North and East Ridings; the lighter glacial soils; the Limestone and Chalk soils; many of the alluvial soils, especially the heavy alluvium in the southern portion of the Vale of York and in Holderness; artificial and natural warp soils, occurring chiefly near the River Ouse and the Humber; the Boulder Clay soils in the northern Pennine district, where there is an abundance of limestone, and where the drift consists to a considerable extent of limy material, or where it covers thinly the limestone and the calcareous shales. Most of the sourer types of soil will also give a marked response to phosphates, provided they have at some time been limed sufficiently heavily.

Indications of the Need for Phosphates.—Some of the commonest indications to be found on land in suitable condition for phosphatic manuring are growths of hawthorn and wild rose, which, if neglected long enough give rise to strong bushes requiring considerable labour in stubbing or cutting when the improvement of such land is undertaken; sedges (commonly known as carnation grass) often occur in abundance; clover plants can be found, although they are badly developed, and the herbage generally is weedy, poor and thin; rest harrow is common on some land of this type; on lighter and drier soils, and especially on the tops of the ridges where the land is in ridge and furrow, the fescues often become the most important grasses; plantains are very noticeable, and land regularly mown is sometimes infested with yellow rattle. Tor grass often takes possession of pastures on drier situations where the land is limy, although it is by no means confined to light soils, and may often be quite common on heavy marls, especially those overlying limestone.

The conditions set out above are typical of phosphate-starved land, which will usually give a very marked response to phosphate properly applied. It does not often give any noticeable response to applications of lime; on the contrary liming frequently appears to reduce the amount of herbage already growing, and in such cases lime is often considered to do more harm than good. This effect of lime was noticeable on North Riding Boulder Clay at Brompton, Romanby and Thornborough. At other centres, e.g., Howden (heavy alluvial soil). Bedale (light river alluvium) and Bramham Park (magnesium limestone soil), lime alone has had no noticeable effect on the herbage.

It has to be borne in mind when improving such soils that the first marked improvement consists chiefly in the development of the wild white clover, and as this plant objects almost as strongly to the presence of coarse rough herbage which constantly overshadows it, as it does to the deficiency of phosphate, it is frequently advisable to take steps to remove and keep down such coarse grasses as the tor grass when applying phosphate. It is also important to remember that the stubbing or cutting of the bushes, the burning off and severe harrowing of tor grass, rest harrow, etc., will not by itself usually effect a permanent improvement. Unless the soil conditions are improved at the same time the land quickly reverts to its former state, and it is generally a waste of labour to carry out such mechanical treatment without supporting it with adequate applications of phosphate.

An excellent demonstration of the effect of combining the mechanical and manurial treatment has been obtained on a series of plots in Bramham Park, where Plots 1 and 2 in the following series gave by far the best results:—

Plot 1.—Severely harrowed and 10 cwt. per acre of 38 per cent. basic slag applied.

Plot 2.— Do. do. do.
with 2 lb. per acre of wild white clover seed sown.

Plot 3.—Untreated.

Plot 4.—10 cwt. per acre of 38 per cent. basic slag.

Plot 5.—2 tons per acre of magnesian limestone.

One portion of a series of plots at Brompton was very severely harrowed before the manures were applied. During the first year or two after treatment the clover runners were spreading along the cuts made in the rather matted turf. In the second and third years, however, the improvement, due to the application of basic slag, was so marked on both harrowed and unharrowed land that there is now no noticeable difference due to harrowing. The effect of the harrowing seems to be most important during the first and second years.

Phosphate Manures to Use.—At a number of centres, trials have been laid down with different types of phosphatic manures. At many of these centres the trials are not yet complete, and they will probably continue to give useful information for several years to come. Some important deductions may, however, be drawn from the results available.

All trials include, in addition to a plot which receives no phosphate at all, a standard plot receiving 10 cwt. per acre of a 38 per cent. Bessemer basic slag, so that in every case, on all

types of soil chosen, the phosphate manures are being tried against the old and well-known type of basic slag.

Ground Mineral Phosphate.—On the North Riding Boulder Clay at Romanby, on land which is not in ridge and furrow, the North African phosphate has given better results than at any other centre. During the first season and the beginning of the second after its application the mineral phosphate plot was distinctly behind that which received 38 per cent. basic slag. Towards the end of the second season there was no noticeable difference between the herbage on the mineral phosphate plot and that on the slag plot, and the two plots continue to show practically the same improvement.

At other North Riding centres where the fields are in ridge and furrow the improvement from North African phosphate is much more marked in the furrows than it is on the ridges. This applies also to some extent to the other phosphatic manures, but whereas the improvement from mineral phosphate is as good as that from 38 per cent. slag in the furrows it is not so good on the ridges.

Under drier soil conditions such as one finds on the ridges or on lighter drier soils ground mineral phosphate has given noticeably poorer results than 38 per cent. basic slag, and it has under such conditions usually been one of the least effective of the phosphatic manures tried.

An attempt has been made at a number of centres to increase the effectiveness of an application of the more insoluble phosphate manures by applying part of the phosphate as superphosphate, because, in dealing with cases of bad grassland, there are indications that it is important to give a big initial stimulus to the clovers. The following scheme was laid down at 9 centres in Yorkshire :—

	<i>Quantities per acre.</i>	
<i>Plot 1.</i> —Basic slag 38 per cent.	10 cwt.	
<i>Plot 2.</i> —Nauru phosphate 83 per cent.	4 cwt. 64 lb.	
<i>Plot 3.</i> —Basic slag 16 per cent.	23 cwt. 84 lb.	
<i>Plot 4.</i> —Nothing.		
<i>Plot 5.</i> —Superphosphate 30 per cent.	2 cwt.	
<i>Plot 6.</i> —Basic slag 16 per cent.	20 cwt.	
Superphosphate 30 per cent.	2 cwt.	
<i>Plot 7.</i> —Nauru phosphate 83 per cent.	3 cwt. 96 lb.	
Superphosphate 30 per cent.	2 cwt.	

Plot 4 received no phosphate at all, and the other plots (except No. 5) received equivalent quantities of the various manures or mixtures, *i.e.*, equal quantities of phosphate of lime. Plot 5 was used simply as a control to Plots 6 and 7, which also received superphosphate in addition to some other phosphate.

This series was commenced in the spring of 1922. During the season 1923, especially early in the season the best plot at several centres was No. 3 (low grade slag). Later in the season considerable improvement was noticeable at most centres on Plots 1, 3 and 6, and it was often difficult to choose the best of those three plots. Of the other plots No. 7 was usually better than No. 2.

The effect of applying a portion of the phosphate as superphosphate, where phosphates of low citric solubility were employed, was sufficiently marked to encourage one to suggest that where grassland in ridge and furrow is to receive applications of phosphate manures of low citric solubility—such as ground mineral phosphate or insoluble slags (*e.g.*, Fluorspar slags)—the tops of the ridges might be greatly benefited by an additional small application of superphosphate. One drill width along the top of each ridge will usually embrace all the land under the driest conditions.

Basic Slags.—The response of grassland to low-grade basic slag (16 per cent. total phosphate of lime) has differed markedly, especially in the first season after its application. In several cases the 16 per cent. slag gave by far the best results in the first year. Unfortunately it was not ascertained at the time, and it is not now possible to ascertain, whether the slag used (which was not all from one consignment) had a high or low citric solubility. Stocks of low-grade slags, one of high and one of low citric solubility, have now been obtained, and these are included in series of plots laid down in 1923 and 1924.

The 38 per cent. slag is, of course, of high citric solubility, and one possible reason for the better result obtained from the 16 per cent. slag is the more uniform distribution of the phosphate which can be obtained with $23\frac{1}{2}$ cwt. of 16 per cent. slag per acre than with 10 cwt. of high-grade slag per acre.

The possibility of some other constituent of the slag being responsible for this apparent superiority of low-grade slag has often been discussed, but there is up to the present no experimental evidence in support of it.

There is very little experimental evidence at present on the relative values of “low-grade low-soluble” and “low-grade high-soluble” basic slags on grassland. A number of experiments have been laid down recently in Yorkshire to test this point on a variety of soils, but the results will not be available until next season. On ploughed-out grassland under arable cultivation

and on light and fairly dry soils, the crop yields obtained from low-grade slags of low citric solubility have been very appreciably less than the yields from low-grade slags of high citric solubility. It would seem desirable to avoid the use of low-grade slags of low citric solubility on the lighter and drier soils. Such slags, however, appear to work well under the moister conditions which suit ground mineral phosphate. As it is not possible for the farmer to ascertain the citric solubility of his slags except by submitting a sample to an analytical chemist it is desirable that when he is trying to improve grassland on a light dry soil by applications of phosphate he should use only phosphate manures of high solubility. Whilst low-grade slags may or may not be of high citric solubility, slags of 30 per cent. (or over) total phosphate of lime are usually of high citric solubility.

On heavy soils or on lighter soils with a high water table, and consequently a good supply of moisture, any of the slags or finely-ground mineral phosphate will usually work well on grassland requiring phosphate, but the lighter and drier the soil the more soluble should be the phosphate used if the quickest and best returns are to be obtained. High-grade slags or highly soluble slags of lower grades are always safe and will generally give a good return where phosphate is needed. In addition to these, steamed bone flour or a mixture of superphosphate and steamed bone flour have given good results on light dry grassland, whilst superphosphate alone answers well on chalk or limestone land.

At Kipling Cotes, Market Weighton, on a chalk soil which has no "lime-requirement," the following scheme of plots was laid down in the winter 1922-23 on permanent grass-land:—

Plot 1.—Basic slag 38 per cent., 10 cwt. per acre.

Plot 2.—Unmanured

Plot 3.—Nauru phosphate 83 per cent., 4 cwt. 64 lb. per acre.

Plot 4.—Superphosphate, 4 cwt. per acre.

The plots are to remain down for six years, the superphosphate to be applied in three dressings at two-yearly intervals. At the end of 1923, Plot 1 was the best, closely followed by Plot 4.

Grassland placed in Class 3, and which shows an improvement either when lime alone or slag alone is applied, presents some of the most difficult cases on which to advise the farmer, not so much because it is difficult to say what the land requires (it needs both lime and phosphates as a rule) but because it is difficult to say what will be the most economical treatment.

Unfortunately, until this year, no grazing trials have been made on this type of grassland. The Royal Agricultural Society of England has now commenced a large-scale grazing trial near Clitheroe. This experiment, which is under the supervision of Professor Somerville, should give valuable information for the Boulder Clay on the Pennines.

Some points of interest as to methods of treatment which will give the best results have already been brought out by the Yorkshire plots. The eight series of plots which received originally lime alone and slag alone were cross-dressed two years later with 38 per cent. Bessemer slag at the rate of 10 cwt. per acre. This was applied to one-third of each plot so that in addition to plots receiving lime alone and slag alone there are now plots which have received slag after lime and slag after slag. In four cases out of the five where slag alone and lime alone have both given noticeable improvements the plot receiving slag after lime is now the best plot. The second application of slag to the original slag plot has in no case made an appreciable additional improvement, but this perhaps could scarcely be expected as it was applied only two years after the first full dose of 10 cwt. of 38 per cent. slag per acre.

It is apparently some years before the full effect of an application of lime alone is felt, as it does not during the first year or two give that tremendous stimulus to wild white clover so noticeable when slag is used; the improvement brought about by liming, however, appears to last much longer. It is only on land where the deficiency of lime is not serious that liberties, such as understocking for one or two seasons, can be taken with the grazing without serious deterioration of the herbage.

At Garforth (Field 39) on land limed in 1909-10-11 either by an application of compost (lime, soil, etc.) or of chalk a great improvement has been effected and maintained by periodical applications of basic slag (in 1913 or 1915, 1918 and 1921). A further application of lime applied to one plot in February, 1920, has given no additional improvement. A series of plots laid down on the same field in 1898, which have not been limed, are poor in comparison with the adjoining land, in spite of the fact that they were slagged in 1915, 1918 and 1921.

The improvement brought about by phosphates in these cases appears on detailed examination to be almost entirely due to an increase in the amount of wild white clover. Liming on the other hand appears to encourage the grasses, giving a thicker and taller herbage.

This was particularly noticeable on the plots at Silsden and Beamsley where the herbage on the "slag" and "control" plots appeared much dwarfer than that on the lime plots.

The fresher and greener appearance of the lime plots at these centres was largely due to the checking of woodrush, which originally formed one-quarter to one-third of the herbage. The flower heads of the woodrush which gave such a brown appearance in spring to the control and slag plots developed only to a small extent amongst the thicker herbage of the lime plots.

Most of the grassland of this type is patchy. Some patches contain plenty of clover and are well grazed; these respond well to suitable phosphates. Other patches grow a great deal of coarse, badly-grazed herbage on which the response to phosphates is often slow and uncertain. The most economical way of beginning the improvement of this intermediate type, especially on soils derived from glacial and alluvial deposits, is usually to begin with a suitable phosphatic manure and subsequently to lime those portions of land on which the response to phosphates is not satisfactory. On sour peats and on soils derived from coal-measures and non-calcareous grits and sandstones, on the other hand, it is usually desirable to begin with lime and to continue the improvement by applying phosphates.

Adequate Applications of Phosphate.—Many disappointments have been experienced through the use of inadequate applications of phosphate. The initial application in such cases should not be less than the equivalent of 10 cwt. per acre of a phosphatic manure containing 30 per cent. total phosphate of lime. It is usually more economical to apply the phosphate in any one year, at the above rate, to whatever acreage the available supply will cover, than to manure a larger area at a correspondingly lower rate of application. Where the land has been badly grazed every effort should be made by burning (if necessary) and harrowing to expose the soil on the rough patches immediately before applying either lime or phosphates. Whatever the material used it should be applied under fairly dry conditions. Either lime or slag if applied to grassland when wet on the surface is inclined to run together and set, a great deal of the advantage from having the material in a fine dry condition being thus lost.

Botanical analyses of the herbage on some of the types of grassland discussed are given in Table III. The centres where analyses were carried out are some of those arranged according to soils in Table I.*

* This *Journal*, May, 1924, p. 134.

Botanical analyses carried out in 1920 by Miss L. Scott, of the Department of Botany, University of Leeds, are to be found in the "Guide to Grassland Demonstrations in Yorkshire," obtainable from the Professor of Agriculture, The University, Leeds.

Use of Potash.—In order to ascertain whether a serious deficiency of potash was appreciably affecting the results obtained from an application of lime or phosphates on poor grassland, a cross-dressing of muriate of potash (1 cwt. per acre) was applied to one-third of each plot in the eight original lime-slag series. Some remarks on the results obtained will be found in the last column of Table I (this *Journal*, May, 1924, p. 134).

On the types of soil chosen, including light soils and a peaty soil, it appears that wherever the response to lime alone or slag alone has been unsatisfactory the addition of potash has not made any appreciable difference. The Yorkshire experiments on the point are admittedly incomplete as the trials have been made on a limited number of soil types only. Unsatisfactory results from applications of phosphate to grassland apparently due to a serious deficiency of potash have frequently been reported from other districts.

In some instances where lime or a phosphatic fertiliser effected a noticeable improvement in poor grazing land, the addition of potash produced a further improvement, but in all such cases the additional improvement due to potash was small in comparison with that due to lime or phosphate alone.

From the Yorkshire experiments it would seem desirable to make phosphates (and lime if necessary) the first charge on funds available for the improvement of poor grazing land, and to provide adequate applications of phosphate for the whole area to be improved before supplementing such treatment by the addition of potash. In the case of better grassland, or grassland on which phosphates have been used previously, the question of using potash should be considered. There are few reliable indications of potash starvation in permanent grassland; grassland on heavy soils as well as on light soils is sometimes in need of it. Further trials will be necessary. The evidence available is more definitely in favour of the use of potash for hay crops from temporary leys or permanent meadows, especially if no farmyard manure is used.

The Analyses in Table III were carried out in 1923 by Mr. R. E. Edwards, Department of Agriculture, University of Leeds. The centres are arranged according to the way in which the grassland responds to lime or to slag. The lime-requirements of the soils are given for comparison. The figures opposite the species of grasses or clover are percentages of the total area covered by each species.

TABLE III.

BOTANICAL ANALYSES OF HERBAGE (1923).

Centre.	Improved by liming.				Improved by slag.		Improved by lime alone and by slag alone.						
	No apparent improvement from slag.				No apparent improvement by liming.								
	Saddleworth ²	Batley.	Sharlston.	Swine.	Thornborough.	Bramham Park.	Nostell.	Parlington.	Silsden.	Beausley*.	Thornton-le-Bears.	Ainder by Steeple.	Dunsell.
Fescues ...	32	34	27	13**	17	23	23	42	21	16	43	18	3
Cocksfoot ...	—	7	1	—	3	3	7	—	—	—	—	—	8
Perennial Ryegrass	—	1	—	5	4	—	5	—	—	1	—	4	21
Other good grasses	1	13§	2	8	3	—	2	4	3	—	2	4	7
Rent Grass...	17	17	25	38	12	4	19	12	22	39	19	22	16
Yorkshire Fog ...	13†	—	8†	34	23	1	4	1	3	1	2	7	15
Other bad grasses ...	4	—	—	—	3	63††	6	1	10	4	—	5	1
Wild White Clover	1	—	—	—	10	1	12	13	1	1	4	3	23
Other Clovers ...	9	—	—	—	8	—	—	1	—	—	—	—	—
Woodrush ...	—	—	5	—	2	—	2	13	25	31	10	3	—
Sheep's Sorrel ...	—	1	4	—	1	—	—	—	1	—	1	—	—
Other Weeds ...	13	6	2	2	14	1	10	11	6	7	16	33	6
Number of species of plants noted ...	13	9	9	9	23	24	20	21	20	20	13	20	17
Lime requirements of soil ...	56	60	49	68	16	0	25	23	30	22	23	26	30

* Analyses by Miss Scott (1920).

† Analyses by Mr. T. Swarbrick.

† All *Holcus mollis*, no *H. lanatus*.

§ Chiefly Smooth-stalked Meadow Grass.

** Chiefly *Festuca ovina*.

†† Including Tor Grass (44%) and Erect Brome Grass (15%).

FEEDING EXPERIMENTS WITH SILAGE.

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THE erection in recent years of considerable numbers of tower silos, and the enthusiastic reports of the owners, indicate clearly that the making of silage must now be regarded as a thoroughly established practice on many farms in England, especially in the Midland and Eastern Counties. Accordingly, it is becoming more and more important that as much knowledge as possible should be accumulated concerning silage and its uses, and it is in the hope of the results having some value in practice that the following account of experiments with dairy cows is published.

The plan of the experiments follows that usually adopted:—Two groups of cows as evenly balanced as possible, a preliminary period for the animals to become accustomed to the rations, the first period of actual recording, a change over of the groups with another preliminary period, and then the second period of recording. The silage used in Experiment 1 was sainfoin, and in Experiment 2 oats, tares and beans.

Experiment 1.—Silage + Roots v. Roots Only.—Undoubtedly for a long time the most common set of conditions will be where the farmer is replacing part of his roots with silage. Few farmers will be so radical in their methods as to go in entirely for silage instead of roots. The question then is: “Having replaced part of my root break by silage, what is the best method of replacing part of the roots in the ration?” Chemical analysis suggests that advantage should be taken of the higher content of albuminoids in the silage, and the rations in Experiment 1 were drawn up with this object.

This experiment was carried out on the farm of Mr. Frank Harvey, of Hadham Hall, Bishop's Stortford, during the first quarter of 1924. We are greatly indebted to him and to his partner, Mr. Pocock, for the facilities provided, and for the enthusiasm and care with which the feeding and recording were carried out. Ten cows were selected from the herd of 35 heavy-milking Shorthorns and Friesians (the average of the herd is

920 gallons), but for convenience in feeding they were divided into two unequal groups of 6 and 4. As will be seen from Table I the selection was very satisfactorily carried out.

The Sainfoin Silage.—This was made from the first cut of the third year of the sainfoin ley, and was cut in June, 1923. The silo is of brick, and was constructed in 1918. The sample would be described as a very fine sample of acid silage, light green in colour, and with a most appetising smell.

Analysis.—

Water	75.4	The oil is rather higher and the albuminoids (protein) lower than might have been expected.
Crude Protein	...	...	3.9
True Protein	...	...	2.8
Crude Oil	2.2	Estimated starch equivalent: Between 10 and 11 lb. per 100.
Soluble Carbohydrates	...	...	9.1
Fibre	...	...	7.7
Ash	1.7	

Rations used.—

			<i>Ration 1.</i>		<i>Ration 2.</i>
			<i>lb.</i>		<i>lb.</i>
Roots...	...	...	70	...	30
Silage...	...	...	nil	...	40
Hay	...	...	8	...	8
Oat Straw	...	...	7	...	7
Linseed (boiled)	...	...	1	...	1
Beans	...	...	4	...	3
Oats	...	...	4	...	3

The basis of substitution was, therefore, 40 lb. silage = 40 lb. roots + 1 lb. beans + 1 lb. oats. These rations were for cows giving $2\frac{1}{2}$ gallons per day. In addition, for every gallon over $2\frac{1}{2}$ a mixture of equal parts of beans and oats was given at the rate of $3\frac{1}{4}$ lb.

The preliminary period started on 8th January, the first three weeks of experiment on 15th January; the week of change over was from 5th to 11th February, and the experiment terminated on 3rd March.

Results.—Throughout there was no difficulty in feeding either of the rations, and there was no appreciable difference of effect on the condition of the cows. Owing to the unequal size of the groups the total production of milk on the two rations cannot be taken as a measure, as it would not allow for the advance of lactation, but the following Table (No. I) and Diagram No. 1 show clearly that for practical purposes the two rations were identical:—

TABLE I.

	Root Ration. 8th Jan. to 4th Feb.		Silage + Root Ration. 5th Feb. to 3rd Mar.	
	Average yield per cow on 15th Jan.	Average yield per cow on 4th Feb.	Average yield per cow on 12th Feb.	Average yield per cow on 3rd Mar.
Group "A" (6 Cows) ...	30.8 lb.	29.1 lb.	29.3 lb.	27.2 lb.
	Silage + Root Ration. 8th Jan. to 4th Feb.		Root Ration. 5th Feb. to 3rd Mar.	
	Average yield per cow on 15th Jan.	Average yield per cow on 4th Feb.	Average yield per cow on 12th Feb.	Average yield per cow on 3rd Mar.
Group "B" (4 Cows) ...	30.8 lb.	28.9 lb.	29.3 lb.	27.3 lb.

At the commencement of the first period of experiment (15th Jan.) the average daily yield in both groups was exactly the same (30.8 lb.); at the end of the first period (4th Feb.) it differed by only $1/5$ lb.; at the beginning of the second period of experiment (12th Feb.) it was again identical; and at the end, the difference was only $1/10$ lb.

In Diagram No. 1 is plotted the average daily milk yield per cow taken over three-day periods. The milk of each cow was weighed at every milking, but to smooth out the minor fluctuations which invariably accompany daily yields, averages were determined from the total output of each group during successive three-day periods. It pictures clearly the normal falling off of yield in both cases as the period of lactation advances, and also shows the very small maximum difference between the two groups—a difference of only one-fifth of a gallon.

Cost of the Two Rations.—The difference in cost per cow per day in the two cases is the difference in cost between 40 lb. roots + 1 lb. beans + 1 lb. oats and 40 lb. silage. Mr. Harvey's costs of production were very carefully estimated, and it was concluded that the sainfoin silage and the roots were each produced at a cost of about £1 per ton.

	Pence.
40 lb. Roots at £1 per ton	= 4.28
1 lb. Beans at £12 „ „	= 1.29
1 lb. Oats at £10 „ „	= 1.06
	<hr/>
	6.63
40 lb. Silage at £1 „ „	4.28
	<hr/>
Difference ...	2.35d, daily per cow in favour of silage.

For a winter period of 180 days this difference amounts to £1 15s. 2d. per cow; or for a herd of 30 cows to £52 16s. Otherwise expressed it represents a difference of 0.8d. per gallon for an average daily yield of 3 gallons.

Conclusion.—Apart from any question of cost of production it is evident that the value of the silage was not over-estimated and that the basis of substitution was a reasonable one. We are of opinion that this method of utilising silage, viz., to replace some roots and some concentrates will often prove the most economical one in farming practice.

Experiment 2.—Silage v. Roots + Silage.—In this case the comparison was between one ration containing a normal amount of roots together with a moderate amount of silage, and the same ration in which the roots were replaced by approximately half their weight of silage, so that the second ration included what would be regarded as a large weight of silage. The results, therefore, apart from the comparison, are of interest in suggesting a suitable ration where roots have been entirely replaced by silage crops or where, for other reasons, they are not available.

Through the kindness of A. S. Bowlby, Esq., Gilston Park, Harlow, the experiment was carried out with 12 cows selected from the Overhall herd of 70 Friesians, under the supervision of Captain S. E. Buckley. Here also we should like to express our keen appreciation of the interest shown, and the great care with which the feeding and recording were done.

Particulars of the Silage.—The seeding was 2 bushels tares, 1 bush. beans, 1 bush. oats, $\frac{1}{2}$ bush. wheat; and cutting took place towards the end of June and in early July. The silo was Gascoigne's "Economic" Steel type. This was a nice sample of acid silage, light green in colour and appetising in smell.

Analysis.—

Water ...	...	...	77.3			
Crude Protein ...	...	...	3.5			
Pure Protein ...	...	...	2.2			
Crude Oil ...	...	...	1.7			
Soluble Carbohydrates ...	...	...	7.8	Estimated	Starch	Equivalent
Fibre ...	...	...	7.5	10 lb.	per 100.	
Ash ...	...	...	2.2			

Rations.—

			Ration 1.		Ration 2.
			lb.		lb.
Roots	...	...	56	...	nil
Silage	...	...	23 $\frac{1}{2}$	...	50
Hay ...	...	...	14	...	14
Oat Chaff	...	...	4	...	(4)

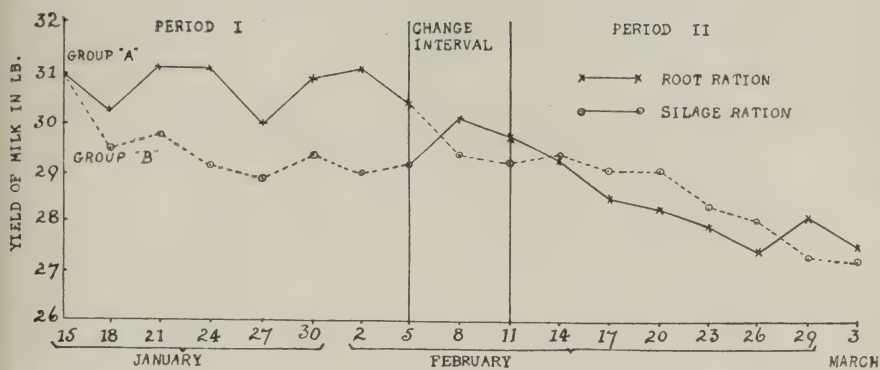


FIG. 1.—Average Daily Yield over 3-day periods.

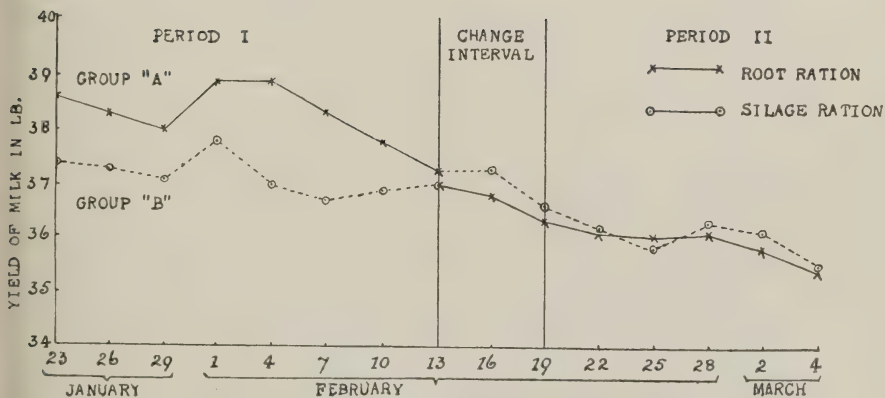


FIG. 2.—Average Daily Yield over 3-day periods.

Here the substitution is $26\frac{1}{2}$ silage = 56 roots, or approximately 1 of silage for 2 of roots. In addition for every gallon above one, $3\frac{1}{2}$ lb. of the following mixture:—beans 2 lb., oats 2 lb., dried grains 2 lb., wheat or barley 2 lb., ground nut cake $1\frac{1}{2}$ lb., fish meal $\frac{1}{2}$ lb.

During the first few days of the preliminary period it was thought doubtful whether the cows would consume 50 lb. of silage. The oat chaff was, therefore, omitted from the ration and more time given to the cows for watering. By the end of the preliminary period the cows were clearing up their 50 lb. of silage, but during the experimental period the oat chaff was not again included in this ration. The supply of water is without doubt an important point when feeding large quantities of silage.

Results.—The results are presented in the same form as those of Experiment 1.

Preliminary Period	...	16th—22nd January.
First Experimental Period	...	23rd January—12th February (3 weeks).
Period of Change	...	13th—19th February.
Final Experimental Period	...	20th February—4th March (2 „).

TABLE II.

Group "A" (6 Cows)	...	Root Ration. 16th Jan. to 12th Feb.		Silage Ration. 13th Feb. to 4th Mar.	
		Average yield per cow 23rd Jan.	Average yield per cow 12th Feb.	Average yield per cow 20th Feb.	Average yield per cow 4th Mar.
		38.6 lb.	37.7 lb.	36.4 lb.	35.5 lb.
Group "B" (6 Cows)	...	Silage Ration. 16th Jan. to 12th Feb.		Root Ration. 13th Feb. to 4th Mar.	
		Average yield per cow 23rd Jan.	Average yield per cow 12th Feb.	Average yield per cow 20th Feb.	Average yield per cow 4th Mar.
		37.4 lb.	36.8 lb.	36.0 lb.	35.4 lb.

Here, again, Table II and Diagram 2 show clearly that there was nothing to choose between the two rations. This is particularly well shown during the interval of changing over; the slow rate of fall continues unaltered as though the cows were quite unaffected by the change from roots to silage and *vice versa*.

Comparison of Cost.—Since the oat straw chaff was removed from the silage ration $26\frac{1}{2}$ lb. silage replaced 56 lb. roots + 4 lb. chaff.

The actual costs of production were:—silage, £1 7s. 1½d. per ton; roots, £1 0s. 4d. per ton; oat straw chaff was valued at 45s. per ton.

	Pence.
56 lb. Roots ... at £1 0s. 4d. per ton =	6.1
4 lb. Oat Straw Chaff at £2 5s. 0d. „ „ =	.96
Total	7.06
26½ lb. Silage ... at £1 7s. 1½d. per ton =	3.85
Difference	3.21d.

As before, the silage ration is distinctly cheaper than that including roots: For a herd of 30 cows over a period of six months the difference in favour of the silage ration without roots would amount to £72 4s. 6d. For a 3-gallon average the difference is just over 1d. per gallon.

* * * * *

A FRENCH BROCCOLI PACKING STATION.

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THE fickle climate of England during the winter months often gives great anxiety to growers who are bold enough to attempt the growing of green vegetables for market purposes during the months of January, February and March. The prevailing temperature during this period is usually so low that plant-growth is extremely slow, whilst at times frosts are so severe as to injure all succulent and young growth. In the presence of such obstacles production on a general scale is only attempted in a few areas specially situated and protected from winter's frosts, or so situated as to benefit from the heating effect of the warm gulf stream. One such district is the Penzance area of Cornwall, where the White Broccoli grows and develops large and fine white heads during the winter, whilst the growth of similar varieties in other districts is usually imperceptible. Though this is perhaps the only important home area, its products do not enjoy the monopoly of the market, but have to compete with similar products from France (Brittany) and from Italy (Milan).

With regard to the supply from Brittany, figures supplied by the Southern Railway show that during the months of December, 1923, and January, 1924, the boats from St. Malo to Southampton brought 4,581 tons of "Choux-fleurs," including

both cauliflowers and broccoli. This figure indicates that the French industry is flourishing and that its products presumably find a ready market in this country. The subject merits closer consideration and analysis, for it may be that some feature of the French industry may be of interest and use to home-growers in helping them to compete in the home markets.

The Southern Railway boats load for England at the French port of St. Malo, and no doubt some of the "choux-fleurs" are produced by the farmers in that area; but it is known that the majority—which are of the broccoli type—have been grown further west, in the district extending north-east and west of the small town of Saint Pol-de-Léon, in Finistère, Brittany.

The soil is not very different from that found at Penzance, while the methods of manuring are somewhat similar, in that sea-weed is largely used to supply humus to a poor soil, which is further enriched in plant-food by the plentiful use of mixed fertilisers. Forty or fifty cart-loads of sea-weed to the acre and 8 or 9 cwt. of artificials form quite a common dressing. This seems somewhat lavish manuring, but, as will be seen later, the crops grown are gross feeders. The weather is mild but not free from frost, and the district is said to experience less rain than the Penzance area, but the lichens and mossy-coated fruit trees indicate that there is no shortage of atmospheric moisture. The broccoli are produced on small farms of from 3 acres to not more than 8 acres, with perhaps 5 acres as an average. Some of the peasants have taken advantage of a Government system of agricultural credits and borrowed State money at 2 per cent. to purchase their holdings; others simply rent the farms from landed proprietors just as do many farmers in this country. The Breton peasant farmer, having little but his farm to interest him, spends most of his time, from dawn to dusk, cultivating, manuring and weeding his land, as the case may be. His wife and children assist him, and each family is usually sufficient to care for its holding. The practice of hiring labour is almost unknown.

These "peasant farms" are general through France, but the St. Pol-de-Léon industry is exceptional in that it is specialised for the production of selected vegetable crops, of which the artichoke, broccoli, early potato and onion are the most important.

The artichoke is grown for the French markets, though doubtless supplies would be sent to England were the English people to develop a taste for it.

Broccoli, grown formerly for the French market, has achieved such success that more than half of the total crop is exported annually to England, Holland, Germany and Switzerland. The onions have been made well known in England by the Breton peasant growers, who, dressed in their quaint costumes, yearly tour England selling their strings of onions, and, at the same time, acquiring a knowledge of the English language. For the potato industry the growers cultivate two kinds in some quantities: a yellow-fleshed early variety for the French markets and the old Up-to-Date for export to England.

Methods of Cultivation.—At the time of the writer's visit (February) the peasants were busy marketing the broccoli crop, and one was able to visit the fields and markets and obtain a glimpse into their industry. The broccoli industry dates back for one hundred years or more, during which time it is said the peasants have made no great alterations in the variety grown, beyond annually improving the strain by saving for seed production the largest and most shapely plants to be found in the crop. This practice of seed saving is general. A peasant is reluctant to buy seed, and obstinately refuses to sell seed lest some of his competitors secure his particular strain. The land is well cultivated, richly manured, and kept scrupulously free from weeds, and the plants are given ample room for development, being planted on the square with a distance of one metre ($39\frac{1}{4}$ in.) between each plant.

Under these conditions good crops are obtained, though naturally much variation in size and maturity is present in all fields. St. Pol-de-Léon, like Penzance, is far distant from the market centres and, but for the existence of a good system of marketing, heavy expenses would eat too deeply into the market returns and growers would secure but a fraction of the full market price. It was of special interest, therefore, to study the marketing methods adopted, for it was known that the French package of broccoli had won its way to popularity amongst retailers on the English markets.

The peasants bring their broccoli in carts to the town of St. Pol-de-Léon, where in the market square sales take place daily. When the writer visited the town early on the morning of 13th February, there were 100 or more growers, each with his cart containing from 200 to 300 untrimmed heads of broccoli of varying sizes, making their deals at a price per cart-load with the wholesale merchants. When completed the peasant delivered his load into the packing sheds of the merchants, drew his money in bank notes, and departed.

The merchants' establishment consists of a long open shed where the packing is done, a house and an office. The staff consists of clerks and a number of men and boys skilled in grading, trimming and preparing the crop for market. The merchant's business consists solely in handling and marketing the produce grown locally, and from his skill in doing this he derives his profit.

There was a great similarity between the operations at each packing station. The broccoli from the carts were sorted into heaps of heads of similar size, and these are known as (*a*) giant, (*b*) large, (*c*) English, and (*d*) small. An average cart-load of well-grown broccoli would grade into 10 per cent. of (*a*), 40 per cent. of (*b*), 40 per cent. of (*c*), and 10 per cent. of (*d*). The produce of each grade was kept separate. After grading, the heads were trimmed to remove surplus leaves and portions of stem so that transport expenditure is incurred only on the essential portions. Each trimmer used a very large knife with a blade fully 1 ft. long and 4 in. wide, to cut off all the useless portions of the stem from the base end, and such parts of the leaves as extend beyond the flower head. Some leaves were removed entirely. The waste leaves and stems were reloaded into the peasants' carts, and removed for cattle feeding.

The trimmed heads were collected by boys and carefully packed into crates of a standard size. These crates contained 12 giants, 18 large or 24 English, as the case might be. Special notice was taken of the packing of Grade (*c*), for that sample is usually sent to English markets. The 24 heads of broccoli were arranged in three layers, each of which consisted of a double row of 4, arranged so that the stems all pointed outwards and the heads lay in the middle.

A well-packed crate has the appearance of being a little too full, and when the top is closed with the thin wooden bars, a perceptible outward bulge occurs. These bulging bars constitute a spring which holds the broccoli heads secure and steady during transport.

The crates carry trade-marks of the several packing houses and the letter A, B, C or D, as a distinguishing grade-mark. They are packed into railway vans, each of which contains about 5 tons, and are despatched by rail to France and Germany, and to St. Malo for England.

A Co-operative Packing Station.—One of the packing stations visited, known as "La Bretonne," is run co-operatively by a group of farmers. In size and business turnover

this station ranks third in the district. The peasant farmers supporting the society deliver their loads of broccoli direct to the station, and so save the process of selling in the market of St. Pol-de-Léon. The loads of broccoli are sorted into the several grades, and the numbers of broccoli of each grade are entered into the society's books; and on this entry the share of the market returns of each grower is calculated. From this stage onwards the identity of each individual grower's produce is lost, for it is trimmed, packed and marketed as before mentioned.

At present the co-operative society is in a strong position. It has a large turnover and is effecting good sales. The manager—Monsieur Berest—stated that the growers were getting about 8 per cent. more for their produce by marketing through their own packing station than by selling to the merchants. The present successful position of the society has been reached after years of toil and disappointment, as the following notes indicate.

The society was started in 1910, with a capital of 20,000 gold francs, and a membership of 100 growers. The early efforts proved unsuccessful—money was lost and members dropped out—and to prevent the society from becoming defunct the French Ministry of Agriculture in 1912 advanced a loan of 50,000 gold francs at 2 per cent., for the repayment of which all the members had accepted a personal pledge and responsibility. Experience had been gained and more prosperous times were ahead, and by 1920 the society gained such a strong position that it was able to repay the Government loan and carry on the whole business without difficulty. Further progress has been made with each succeeding year, and now the society has a turnover exceeding 2,000,000 francs.

The operations of this packing station are not limited to the trimming, grading, packing and selling of the broccoli crop, but it handles in a similar manner most of the vegetable crops of its farmer members. The society, for instance, marketed in 1923, artichokes to the value of 600,000 francs, potatoes 450,000 francs, broccoli 400,000 francs, and miscellaneous crops (such as onions, garlic, etc.) 150,000 francs. The society also purchases manures in bulk, makes its own mixtures for sale to its members, distributing during last year over 300,000 francs worth of manure.

This story of the successful working of a farmers' packing station on co-operative lines should be of considerable interest and use to home-growers at the present time, now that British

markets have become particular that produce shall be specially graded and packed. To understand this is simple; to effect a proper marketing system in practice is more difficult, because each individual grower finds he has no skilled and expert grader and packer or that, when graded, the number of packages of each grade is too small to effect good sales. Each has been brought up in the belief of individual enterprise, yet the experience of the French packing stations demonstrates that by a combination of growers it is possible, by setting up packing stations and marketing societies, to handle large blocks of similar kinds of produce, and to achieve a great success in both home and foreign markets.

* * * * *

THE CULTIVATION OF CHERRIES.

I

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CULTIVATED cherries fall roughly into two main groups, usually referred to as "sweet" and "sour" cherries, which differ from each other in many respects. The former comprise the Gean and Bigarreau, classed as dessert cherries, and the latter, the Flemish, Kentish and Morello varieties, classed as cooking cherries. The sweet cherries appear to have been derived from the wild Gean (*Prunus avium*) and the sour cherries from the common wild cherry (*Prunus cerasus*). Both these natural species are believed to be indigenous to this country.

I.—SWEET CHERRIES.—By far the greater proportion of sweet cherry trees are grown as standards in grass orchards, and there is no doubt whatever that this method of culture is the most suitable. It is true that they may be, and actually are, grown on cultivated land, but the attendant difficulties are many and, unless there are reasons against it, all cherry orchards should be grassed down after the tenth or twelfth year. On grass the trees do not tend to make rank growth and can be kept in a better fruiting condition. There is also less inclination to "gumming," so marked where trees are on cultivated land. Another and even more important reason in favour of grass is the fact that cherries are largely surface rooting and are adversely affected by root disturbance.

Soil and Situation.—Cherries prefer light, well-drained soils, and undoubtedly such soils as so-called "brick-earth" and

light medium loams are the best when there is good under-drainage. The trees succeed well on the true chalk formations when there is a good top depth of loam. They do not thrive on cold heavy clay, such as Wealden clay or on badly drained soil of any kind.

Situation is very important, and the various aspects of the land to be planted should be carefully considered. Cherries blossom very early in the season, hence the necessity for choosing an open situation. One where the sun will come gradually on to the blossoming trees will mitigate the risk of damage from frost scald. Deep valleys and sites where the configuration of the land tends to form frost pockets should be avoided.

Blank, wind-swept situations open to the south-west are undesirable unless a wind-break of poplar or other quick-growing timber can be planted. Access is required to a water supply both for tree-washing and for the grazing stock.

Propagation.—Sweet cherries for orchard growth are usually worked on the Gean or Gaskin stock (*P. avium*). The stocks are grown from seed by Continental nurserymen and imported into this country. The stocks are generally top grafted, working at 6 ft. high if standard trees are required. Some growers prefer to plant the stocks in their permanent tree position and to delay grafting until the stocks have become established. This is only possible where a supply of Geans can be obtained in the local woods, but there is a decided balance in favour of raising the trees in a nursery or purchasing them ready for planting from a reputable nurseryman. Standard trees for planting out should be the usual trained standards 3 to 4 years old and from 5 ft. to 6 ft. in height. They should not in any case be less than 5 ft. 3 in. in height.

The Mahaleb as a stock for cherries for thought to have advantages over the Gean, where less vigorous growth was desired, but recent investigations have shown that this stock is just as vigorous as the Gean and it is not much employed.

Planting.—There are at least three methods which may be employed in establishing a cherry orchard. The first, and perhaps that most frequently adopted, is to inter-plant the cherries with fillers of apples and plums, or both, and with bush fruit occupying the ground beneath. This mixed fruit plantation is then managed, and the land cultivated, in the usual way for upwards of ten years, when the bush fruit is taken out and the land grassed down. As the cherry trees develop, the apples and plums are also removed to give room. This method

is the most economical, and can be recommended, as the plantation receives proper cultivation and constant manuring, and the cherries secure a good start and produce strong well-balanced trees.

The trees may also be planted direct on existing grass land, but growth is much slower.

A third plan is to plant the trees amongst hops, but experience has shown that this is the least satisfactory method, for when the hops are grubbed and the land grassed down the quickly-grown and succulent cherry trees experience a severe check.

The correct spacing of the trees by either method is all-important, for cherry trees grow to a considerable size and last in a profitable condition for over 60 years, and it is important that when fully grown the trees shall not become overcrowded. The tree cannot be restricted by cutting, for cherries will not tolerate such treatment. Economy of space may be obtained and more trees planted to the acre by planting the less vigorous and more upright-growing varieties alternately with the strong-growing, spreading sorts.

As a rule most varieties on standards should be spaced from 30 ft. to 40 ft. apart each way, but never closer than 30 ft. A satisfactory distance, when trees are judiciously arranged as described above, has been found to be 32 ft., giving 50 trees to the acre.

The actual cultivation of the land, as well as the general planting procedure, which is the same for cherries as for all other fruit trees, is fully described in the Ministry's Leaflet No. 148 (*Planning and Planting a Fruit Plantation*) and will not, therefore, be described in detail here. The following salient points, however, are worthy of special mention:—

1. The equilateral triangle system is, on the whole, the most suitable one for cherry trees grown as standards.
2. Good large holes, 3 ft. square and 2 ft. deep, should be dug, and the trees must not be planted too deeply; the nearer to the surface the better. The soil must be well trodden in.
3. The trees should be staked at once, employing for preference two stout creosoted stakes, with a cross piece to which the tree should be securely tied with proper protection against chafing.

Choice of Varieties.—The choice of varieties also requires careful consideration. Although the information available is by no means complete, research has shown that certain varieties are positively self-sterile and that cross-pollination is an important factor in cherry growing.

Self-sterile Varieties

Early Rivers	...	...
Waterloo	...	...
Grosvenor Wood	...	...

Freely pollinated by

Turkey Heart or Black Circassian.
Amber Heart.
Amber Heart.

There is no doubt that the planting of blocks of one particular variety is an unwise practice and has been the cause of crop failure in orchards.

There are many advantages to be gained by choosing varieties which will ripen in succession. In this way the picking can be spread over a longer period, and the market be more regularly supplied.

A list of varieties of proved merit is given below, with notes as to class, season of ripening, etc. As far as possible the name employed in each case is the authentic one, but a good deal of confusion exists as to the nomenclature of cherries, especially amongst growers in different localities. To avoid confusion and disappointment, trees should be purchased from reliable raisers who employ the names indicated and who preserve their stocks free from mixture.

Pruning.—Sweet cherries are spur bearers and fruit without encouragement from the pruning knife. After the tree is once shaped, which will be in three or four years after planting, the trees will thrive best if not pruned at all. If the branches become too crowded in after life the trees should be thinned, and thinning is best done while the trees are in leaf in September, as at that time they are not so prone to "gumming." If the branches sweep down so as to come within reach of live stock they must of course be shortened back.

A certain amount of dead wood will be produced by fully-grown trees, and orchards must be gone over once a year in the autumn or winter for the purpose of removing this. All cuts made on cherry trees should be covered immediately with paint or tar to prevent the entrance of fungus spores.

Management of the Orchard.—In laying down an orchard to grass special care must be taken to obtain a fine turf. A good mixture of the finer grasses only should be sown; the coarser species such as cocksfoot, rye-grasses and oat grasses are best excluded. Clover should not be sown, as the only desirable clover, the wild white, will probably develop of its own accord if the orchard is properly managed.

The orchards are best sown down in the autumn, during August or September, after the last fruit crop has been taken from the bush fruit, if such has been planted beneath the trees.

The land must be carefully cleaned of all perennial weeds such as thistles, docks, nettles and couch grass, and should be made firm before sowing.

Grass orchards should be grazed closely with sheep. In practice grass cherry orchards are usually employed for fattening sheep, numbers of tegs being fed on mangolds, cake and the grass and sold off as they become ready for market. As a rule 10 sheep are run to the acre. If the profit from the sheep is small it must be borne in mind that their main value in the orchard lies in the manure they supply to the trees and the service they render in keeping the grass short. On no account should cherry orchards be allowed to grow crops of hay, as the trees suffer greatly from this practice.

In addition to the organic manure supplied by the sheep the trees demand a supply of phosphate and potash. The application of artificials is a question which must be tackled experimentally until the best results are obtained. Basic slag applied in the autumn is a valuable dressing on some soils, as a source of lime and phosphates, and will also tend to encourage the growth of white clover. Many growers find that a dressing of 2 to 3 cwt. of superphosphate and $1\frac{1}{2}$ cwt. of muriate of potash per acre, applied in the spring, gives satisfactory results.

The application of lime or chalk is also necessary for cherries in common with all stone fruits. Lime may be applied in the form of quick-lime but "ground lime" is preferable. From 15 to 20 cwt. per acre once every three years, or from 5 to 10 cwt., if basic slag is being given, would be a fair dressing. Chalk may be applied in the form of ground chalk and a fair dressing would be 25 to 30 cwt. per acre.

Neglect to feed cherry trees adequately and regularly is a great mistake, for it will be found that the orchard will well repay the necessary expenditure.

The turf should be maintained in good condition by an annual chain harrowing and rolling in the early spring to break down mole and worm casts and to clear off the moss.

An ideal cherry orchard will possess a turf almost like that of a lawn, but kept short entirely by sheep. The latter should be kept off during the winter months, approximately from the middle of November to the middle of February.

Gathering and Marketing the Fruit.—Birds are a trouble to the cherry grower. As the fruit ripens, more and more are attracted. It will be necessary, especially in the case of isolated orchards, to provide a bird scarer from daylight to dark. If the

bird-scarer is provided with a gun he should be warned against firing charges of shot into the trees. Various scaring devices can also be rigged up in the trees themselves.

The worst bird enemies are blackbirds, thrushes, jays and starlings, the latter invading the orchards in flocks and doing a vast amount of damage if left undisturbed. Sparrows also peck off the opening buds and blossoms in the spring, and bullfinches may do a good deal of damage to the buds in the winter. As it costs almost as much to keep the birds off 5 acres as 50, small orchards are not recommended.

The gathering of fruit can be done by women working in gangs with a man to move the ladders and pack the cherries for market. Each tree is picked over once or twice before being finally cleared. Cherries should not be picked when wet, since they will not then travel well. During wet seasons the fruit is liable to crack and rot; extra care is then required to ensure presentable fruit being sent to market.

By far the greater bulk of the sweet cherry crop is marketed in half-sieves holding 24 lb. of fruit. The sieves are lined with paper and the covering paper usually bears the grower's name and address or special mark. In years of scarcity, and in the case of fruit of exceptional quality, pecks holding 12 lb. are used. Picking and despatch of the fruit are done on the same day.

Experience has demonstrated that it pays to grade the fruit into two classes. First grade cherries have been known to realise several shillings more per sieve than the second grade and, moreover, the average price for the whole of the crop will be higher than in the case where no grading is done.

In recognised cherry-growing districts it is often the practice to sell the crop on the tree either at cherry auctions or by private treaty; and, as a rule, in such cases the grower's responsibility ceases with the sale, the purchaser picking and marketing the fruit himself.

There is a market for the finest Bigarreaus for the manufacture of glacé cherries, in which case they are consigned straight to the factory.

Market Varieties of Sweet Cherries.—The cherries described below are named as nearly as possible in order of ripening.

EARLY RIVERS.—(Middle to end of June). *Fruit* fairly large, heart-shaped, shining black when fully ripe, with a small stone. *Flesh* rather tender, juicy, and flavour fairly rich and sweet. *Travels* fairly well. *Tree* is a strong grower with open spreading habit. The branches have

a distinctly drooping effect. A good orchard variety which crops regularly and well. Self-sterile.

GOVERNOR WOOD.—(End of June and early July). *Fruit* large, heart-shaped, pale yellow, flushed with light red. *Flesh* tender, juicy and very sweet. *Stone* small. *Tree* is a strong free grower; habit upright to spreading and crops well. Self-sterile.

This variety, which came from America, has established itself as a good market cherry. The fruit is rather on the soft side and is inclined to crack and rot in wet seasons. It travels only fairly well and requires careful handling.

KNIGHT'S EARLY BLACK.—(Early July). Usually follows Early Rivers very closely. *Fruit* large, obtuse heart-shaped with irregular surface. Dark purple, black, or dead black when fully ripe. *Flesh* purplish red with a sweet rich flavour. *Texture* fairly firm and travels fairly well. *Tree* is a free grower. This is one of the best black cherries, although a medium cropper.

This variety is sometimes referred to locally as Circassian. It is quite distinct, however, from Black Circassian, correctly known as Black Tartarian.

BLACK TARTARIAN (OR CIRCASSIAN).—(End of June). *Fruit* very large, shining purple black or quite black. *Flesh* purplish, rather tender, fine full flavour, stone small. *Tree* of upright, bushy habit, spreading more as it ages, and carrying a wealth of foliage. A first-class cherry and a good, regular cropper.

ELTON.—(Early July). *Fruit* large, heart-shaped, pale yellow, mottled with bright red. *Flesh* pale, tender, sweet and flavour fair. *Stone* medium. Does not travel too well. *Tree* a free grower of spreading pendulous habit. Rather a shy bearer and the fruit is inclined to crack in wet seasons. This cherry is losing favour as a market variety but does exceptionally well in some localities.

FROGMORE BIGARREAU.—(Early July). The earliest of the Bigarreau Class and a little later than Governor Wood. *Fruit* large, obtuse heart-shaped, rather flattened on the side, pale yellow, flushed with red. *Flesh* tender, very sweet and of good flavour. It is firmer than Governor Wood but not quite so large and a better cherry in a wet season. Travels well. *Tree* a free grower, upright to spreading, a good cropper, self-sterile.

BLACK HEART.—(Early to Middle July). *Fruit* fairly large, heart-shaped, uneven, dark blackish-purple. *Flesh* dark red, firm and sweet. *Flavour* fair. *Stone* large. *Tree* makes medium spreading growth; is a regular, free cropper. A very old cherry, doing well in grass orchards and sells well for cooking purposes.

WATERLOO.—(Early July). *Fruit* large, heart-shaped, deep shining black, uneven. *Flesh* fairly firm, sweet, flavour rich, stone small. *Tree* is a free grower of compact upright habit, a little shy in bearing but fairly regular. Self-sterile. A very old variety but a good market cherry, hanging well after ripening and good for wet seasons.

BLACK EAGLE.—(Middle to late July). *Fruit* large, heart-shaped, deep purplish black, full, rich, sweet flavour. *Stone* small. The fruit and habit of tree closely resembles Waterloo but it is a little later. Rather inclined to run off in stoning.

A local variety known as Malling Black Eagle is distinct from this cherry and is not recommended for general cultivation.

AMBER HEART (OR KENTISH BIGARREAU).—(End of July). *Fruit* medium size; even, pale yellow, mottled with dull red. *Flesh* white, juicy and sweet. *Quality* good, *stone* medium. *Tree* grows well with upright, open habit and is a prolific cropper. This variety is very old and is a very profitable one in Kent.

NAPOLEON BIGARREAU.—(Early August). *Fruit* very large, heart-shaped, flattened on one side, pale yellow, splashed with bright red. *Flesh* firm, juicy, full rich flavour. *Travels* well. *Tree* very vigorous, hardy, of spreading habit, a prolific cropper and self-sterile. Rather susceptible to silver leaf disease. This is a fine market cherry, one of the best of this class, and soon makes a tree.

TURKEY HEART (OR THE TURK).—(Middle August). *Fruit* medium, heart-shaped, black. *Flesh* firm and very full flavoured. *Travels* well. *Stone* small. *Tree* fairly free growth, upright to slightly spreading habit

An old variety very popular in Kent. It is one of the first to blossom and therefore liable to frost damage. *Fruit* ripens up rather unevenly.

EMPEROR FRANCIS.—(August). *Fruit* very large, dark red, *flesh* firm, sweet and rich flavoured. *Travels* well. *Stone* small. *Tree* of medium, upright habit. One of the best late cherries and does well in the North.

TRADESCANT HEART (OR NOBLE).—(Early August). *Fruit* very large, heart-shaped, uneven, dark red to blackish purple. *Flesh*, dark purple, firm, slightly acid, rich flavour. Inclined to crack in wet seasons. *Tree* of medium growth, upright habit. This cherry is of recent introduction to Kentish orchards, where it is known as Noble. It is an old variety.

FLORENCE.—(Middle August). *Fruit* very large, heart-shaped, pale yellow, flushed with red, shining. *Flesh* very firm, sweet and of first-rate flavour. *Travels* well. *Tree* a moderate grower, of rather spreading habit. One of the best late cherries and deserves to be grown more for market.

There are other varieties, less known, which possess valuable qualities for commercial orchards, and are also well worth growing.

(To be concluded.)

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NOTES ON POULTRY KEEPING.

C. A. FLATT,

Ministry of Agriculture and Fisheries.

GENERALLY speaking there is a healthy optimism amongst poultry keepers, in spite of the very trying and to some extent disappointing hatching season. At the time of writing (mid-May) the rise in egg prices is encouraging, though slight, and the demand for spring chickens, always ahead of the supply at this season, offers the fortunate possessors of January hatches the opportunity to realise a good profit on their cockerels—so good in fact that there are visions of a shortage of these very early stock birds next autumn.

Hens also are making good prices, and many of the 1923 pullets which have failed to produce eggs of the 2 oz. standard during the spring cycle will leave the yards of reputable breeders for the table.

Incubation.—By the time these notes appear incubators will have been set aside, and a thorough cleansing and disinfection of these should already have taken place.

Writing recently in the "Feathered World," Mr. Edward Brown directed attention to the growth of the "baby chick" hatcheries in the United States, and one may ask how soon the suggestion of the value of similar institutions in this country will take effect. How much of the poultry keeper's capital is tied up in incubators and in buildings in which these are installed? It is true that in a large number of instances, where hatching operations are upon a small scale, no special buildings are set aside. (Incidentally many of these makeshift places are responsible for bad hatching.) There must in any case be a large sum of money earning no dividend for 6 or 8 months of the year, and the small holder poultry keeper can ill afford to have capital lying idle.

Mammoth incubators have already effected great economies in labour, but this is nothing to what might be accomplished with their more extended use. Hatcheries might also lead to recognised breeding centres, which would again be an economy. On the other hand, although poultry keepers sometimes complain of the labour and tie of hatching, to the majority of them this is a particularly attractive part of their work, even to those who bring no special interest to bear upon the problems which face them in artificial incubation. Sentiment possibly enters more largely into the make-up of the English poultry keeper than of his American or Canadian equivalent. Commercially the proposition has a great deal to recommend it.

Housing.—Among the various directions in which great improvement in poultry culture has recently been effected the housing of poultry has taken a prominent part. It is probable that more capital has been put into poultry farming in the past five years than in double that time before. Earlier experiences dissipated the idea that a successful business and a good income awaited the man ready to invest a small capital in poultry farming, and success with a few hundred pounds proved the exception rather than the rule.

The tendency in recent years has in consequence to some extent been reversed, and in a large number of cases the housing

of poultry has been on an extravagant scale. With large flocks, considerable economy can be effected, but large houses are to some extent permanent and it is essential to cut down the cost to a minimum compatible with efficiency, in order to avoid heavy overhead charges on the poultry stock.

With an allowance of only 10s. per head for the housing of the laying hens the annual charge, at the rate of 15 per cent. to cover interest and depreciation—the usual allowance—is sufficiently heavy for the profitable production of eggs for consumption. At this cost it is not a simple matter to attain the ideal and to give effect to all the labour-saving contrivances in accordance with modern ideas.

Extravagance is even more apparent in the buildings erected for chicken rearing. Large brooder houses expensively fitted at a cost of several hundred pounds will take many good seasons to justify their cost. Many such, like the incubators, will only contribute to the dividend for a minor portion of the year, and from this point of view alone, without entering into the advantages in rearing chickens on fresh ground each season, the poultry breeder who prefers to face the weather and greater labour with his flock scattered in smaller units may prove the wiser man. The cost of small portable hover houses is considerably less, and they can be in constant use for one purpose or another throughout the year. They are easily transferred to fresh ground and can consequently be stocked to their fullest capacity at all seasons.

Poultry farm costings have up to the present time been very incomplete, and the relative cost of different methods, taking into full account the labour and efficiency in results over a period of years, as well as the capital outlay, offers a wide field for investigation.

Poultry keeping has increased to a large extent upon general farms, and the farmer has special facilities for cheap housing and at the same time for utilising the fowls for the benefit of his land. A shelter may be constructed of fir poles, with the walls of bracken packed between two layers of wire netting, and straw on the roof. This is all that is necessary for poultry stock of all classes during the next five months of the year at least. The frame will last many years while the walls can be renewed as this becomes necessary. It is surprising that these shelters have not been more generally adopted on poultry farms to meet the temporary increases in stock during the rearing season.

Bacillary White Diarrhœa.—Less has been heard than usual of the troubles caused by bacillary white diarrhœa amongst chickens this season. Whether this indicates a decrease in the disease or a more correct diagnosis of the various ills with similar symptoms it is impossible to say. Nevertheless, many cases have occurred and heavy losses been experienced. An authentic case which has received careful investigation recently serves to illustrate the risks which may be run upon the introduction of fresh stock, even through hatching eggs, and the value of rapid and stringent action to combat the trouble at the outset.

On the farm in question a new breed was to be added. Several hundred eggs were purchased and delivered in two consignments, which were set with an interval of eight days between. Unfortunately the purchased eggs (Breed A) were mixed with a number of the home-bred stock (Breed B) in several compartments of a mammoth incubator. The first hatch duly turned out, and consisted of four compartments of the mixed A and B eggs and one compartment of B eggs.

Orders for day-old chicks of Breed B (the home-bred stock) were dispatched from the compartments of mixed A and B eggs, and a certain number of the B chicks remaining over were placed in a brooder house with the chicks of Breed A. For two days all went well, but at this stage deaths occurred, and within 48 hours the losses assumed alarming proportions. Post-mortem examination revealed the bacillus (*B. pullorum*) causing bacillary white diarrhœa, and precautions were at once taken to prevent the trouble spreading by isolation of the infected chicks and a thorough disinfection of all appliances with which they had come in contact.

Adverse reports were also received of the day-old chicks sent away, and full inquiry revealed parallel experiences in all but one instance. The more fortunate purchaser of chicks from the fifth compartment which had not been in contact with the purchased eggs had escaped trouble. With this one exception the whole of the chickens from this hatch died or were eventually destroyed.

In the second hatch the purchased eggs had been similarly mixed with home-bred eggs, and these were due to hatch within a few days of the outbreak. Action was at once taken, the purchased eggs all being removed to a compartment by themselves, a few being withdrawn for examination. The remaining compartments concerned were disinfected and the home-bred eggs replaced after the shells had been wiped over with methylated spirit.

Of the chicks from this hatch 60 per cent. of Breed A died within a few days. The losses from the batch of home-bred (B) chicks, of which there were approximately 200 chicks, was normal in the first week, amounting to 2 per cent. When examined at this period the chicks were big, strong and healthy in general appearance, but signs of scour and pasting of the vent were apparent in a larger number of cases than is normal. The losses during the next fortnight amounted to 10 per cent., which was well above the average loss experienced on this farm amongst some 2,000 chicks hatched before the outbreak, and it is surmised that they were affected slightly.

Amongst other points in this case it is of interest to note that infection was found to be present in the eggs of Breed A withdrawn from the second hatch and sent for post-mortem examination.

The mistake of the breeder in the first instance in failing to isolate the eggs in the incubator is important to note. It is generally recognised in our very imperfect knowledge of this and other diseases that infection is frequently carried in the egg and spread by the newly hatched chick. But for the prompt action taken as soon as the trouble was suspected, the disease might have spread and caused far greater losses. In this connection the fact that each hatch of chickens on the farm is placed in a brooder house to itself was of assistance in limiting the trouble. On the other hand much anxiety was felt with regard to the incubator; the disinfection of the affected compartments had to be carried out with the machine in full going order, and this prevented the use of formaldehyde gas, especially valuable for disinfection in such cases.

Lack of system and hesitation to act upon the outbreak of disease are often responsible for much of the heavy loss sustained upon poultry farms.

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JUNE ON THE FARM.

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Weather.—June is the first month of the summer quarter and perhaps the most pleasant of the twelve. It is characterised by the maximum duration of bright sunshine, high temperature—but not so hot as July—and moderate rainfall. During June, grass and corn make rapid growth and come into ear; the root crops begin to cast a green shade over the fields that were

apparently bare in May; and all kinds of livestock now show the benefits of a grass diet and an out-door life.

Insects often cause trouble in June: the turnip flea, the mangold fly, and the aphid may attack the root crops; the frit fly if present makes the oat crop "segg"; while in the livestock department the maggot, the warble and the bot flies worry sheep, cattle and horses respectively. Warm conditions favour insect life; but the corn grower's results depend considerably on fine dry weather about the end of the month. A cold, damp spell while cereals are in bloom may reduce the yield of grain by many bushels per acre. Wheat and barley are probably more susceptible to cold and damp than oats; but rye—being cross-pollinated—is even more dependent on fine weather at the flowering stage than wheat or barley. In some parts of Europe hail frequently works havoc among corn crops after the shooting stage—a risk that is in many districts provided against by co-operative insurance.

Grazing.—There are various ways of managing stock out at grass. In a few cases farm animals of all kinds and ages have free range over the entire area of pasture; but where methodical grazing is practised, the fences, gates and waterings are kept in good enough condition for the animals to be confined in the fields allotted to them for the time. Under good management, the economic requirements of the various classes of stock are as far as practicable arranged for: cows in full milk or forward bullocks are given the best bite; calves, yearlings and stirks, or a less forward lot of bullocks, have the second quality of grazing; while the dry cows and heifers, or lean stores come last in the series.

A very common arrangement of the grazing on dairy farms is to allot the pastures to the several classes of stock, somewhat in accordance with their requirements as above stated. As a rule the pastures farthest from the homestead are in lower condition than the home fields; the former are continuously grazed by the dry stock, the cows being conveniently kept nearer home, where also there is the best grazing. The cow pastures are commonly further divided into day fields and night fields, the latter being those adjoining the cow sheds in order that time may be saved in bringing the cows up for early morning milking. Where possible the cool, shady pastures are reserved for grazing in the daytime during hot weather.

An alternative method of grazing is that of eating off each field or area in rotation, depasturing it with the different classes

of stock in successive periods. The whole area of pasture land is mentally divided into three or four lots; the stock are rotated round the farm, the best cattle leading and each class of stock spending about 10 days in each lot. Thus a given field or group of fields is grazed for 10 days by the milkers, then for similar periods by the dry and young stock, and lastly it is rested for 10 days. At the end of the resting period the milkers come into the first field again and consume the fresh clean growth.

The rotation plan requires more detailed attention than that of continuous grazing, the duration of the grazing periods having to be varied according to requirements, to ensure even grazing or a fairly regular flow of milk; the grassland must be of reasonably uniform quality, over the whole of the farm; and when the cows are in distant fields, it is not so convenient for milking, especially in the mornings. The advantages claimed for rotation grazing are, however, that it ensures more even consumption of the entire herbage and that it enables the pastures to carry a heavier head of stock. The grass makes a remarkable recovery during the latter part of the resting period, growth being proportional to the area of leaf surface.

Another method of ensuring progressive grazing, which is customary in Denmark for instance, is that of tethering. The writer has seen over 100 dairy cows tethered in one field, a cowman spending much of his time in moving the tether-stakes and watering the animals. The young stock are more commonly allowed to range.

Turning Out Calves.—While the practice of keeping spring-born calves indoors all their first year is adopted by a number of good breeders, there are others who believe that grazing during the first summer is a desirable preparation for the following grass season. The housed calf may appear to have made better progress up to the age of 12 months; but another that has learnt to graze as a calf, it is held, makes the better animal in the end. Experimental evidence on this point is not available; but it is generally agreed that discretion must be exercised in the matter of the time when the calves are to begin lying out of doors. They easily contract chills and lose condition, if the change from indoor to outdoor conditions is made suddenly, especially when the nights are cold. For calves of dairy breeds dropped after February, June is early enough to begin turning out, and box food should be continued until they are six months old.

Arable Land.—June is normally an important weeding month. In corn there may be thistles to be spudded and docks to be drawn out before the crop is too high. Sometimes the docks pulled up are not burnt, and frequently they seed, in spite of having been lifted out of the ground. Horse hoeing performed in this month with a view to the destruction of weeds, the aeration of the soil, and the conservation of moisture, is an essential feature of good green-crop cultivation. Occasionally the mistake is made of paring the soil down too close to the plants, leaving them perched on a narrow ledge of earth from which all the moisture quickly escapes. It is possible to hoe close to the line of plants without injury, unless the soil is too hard and dry; but for this work the implement must be equipped with special blades, such as those formerly made under the Goss and Savage patents. But whatever type of blade is used, any deep drill-grubbing necessary should be completed early in the summer, as at the ordinary time for the third horse-hoeing in July the root fibres may be too near the surface to allow of more than superficial stirring.

The first side-hoeing and singling of mangolds may by this time be completed in the earlier districts; but generally this crop and swedes make heavy demands on the labour supply right up to the time when all hands are required in the hay field. Undoubtedly root-cleaning operations could in many cases be accelerated by the fuller use of mechanical side-hoes. There are also hand-pushed appliances on the market with which a man can efficiently side-hoe $1\frac{1}{2}$ acres per day where, with an ordinary Dutch hoe, he would hardly cover a third of that area.

As regards singling, no machine on the market can be so satisfactory as good hand labour, as even the best machine can only make gaps in the row of plants, the actual singling having to be done by hand. Possibly too great stress is laid upon the desirability of absolute regularity of spacing and on adherence to what is thought to be the correct distance between the plants: experiments have failed to provide a satisfactory answer to the problems of what are the best distances at which to single. Of the desirability of the early removal of the surplus plants, however, there is no question: on which account the shortcomings of the mechanical thinner may be less serious than the delay due to shortage of hand labour.

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MONTHLY NOTES ON FEEDING STUFFS.

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AN interesting series of observations is contained in a farmers' bulletin recently published by the Animal Husbandry Section of the Iowa Agricultural Experiment Station. The problem dealt with was the need for salt for ewes during the gestation period.

Rock Salt for Ewes.—It is a common practice in sheep feeding districts to allow sheep free access to rock salt. Observations were carried out by the Iowa Station extending over 7 years and covering no less than 28 flocks of ewes, in order to ascertain first, the amount of salt used by ewes during the winter period, and secondly the extent to which the ewes and resultant lambs benefited or deteriorated by the salt feeding. The ewes were allowed free access to salt. The highest daily consumption of salt per ewe was 0·8 oz., the lowest just over 0·1 oz. As would be expected, the demand for salt varied with the type of feeding stuffs given. The average consumption of salt worked out at 0·42 oz., or just under $\frac{1}{2}$ oz. per head per day. An experiment was further carried out to test the effect of feeding salt to ewes. Four experimental comparable groups of ewes, 10 in each group, were fed from November, 1919, until lambing with the following amounts of salt per head per day. Lot 1. No salt. Lot 2. $\frac{1}{4}$ oz. Lot 3. $\frac{1}{2}$ oz. Lot 4. 1 oz. The ewes averaged 124 lb. live weight at the commencement of the experiment. The average ration fed during the experimental period was grain 1 lb., maize silage 3 lb., mixed hay 1 lb. per ewe per day. The grain mixture consisted by weight of maize 20 parts, wheat bran 20 parts, linseed meal 10 parts. The mixed hay consisted of clover 9 lb., Timothy 1 lb. The following results were obtained:—

	Average daily gain per ewe.	No. of ewes lambing.	Fleece weight at shearing.	Loss in scouring per cent.
Lot 1.—No salt ...	·278 lb.	10	7·63 lb.	46
Lot 2.—Light salting...	·318 lb.	10	8·04 lb.	36
Lot 3.—Medium salting	·322 lb.	9	8·52 lb.	35
Lot 4.—Heavy salting	·311 lb.	9	7·65 lb.	39

DESCRIPTION.	Price per Qr.		Price per		Manurial Value per Ton.	Cost of Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv.	Price per lb. Starch Equiv.
	s. d.	lb.	Cwt.	£ s.					
Wheat, British - -	—	—	11/3	11 5	0 16	10 9	71·6	2/11	1·56
Barley, British Feeding	—	—	10/9	10 15	0 12	10 3	71	2/10	1·52
" Canadian No. 4	—	—	—	—	—	—	—	—	—
Western	34/-	400	9/6	9 10	0 12	8 18	71	2/6	1·34
" Argentine - -	35/9	"	10/-	10 0	0 12	9 8	71	2/8	1·43
" Tunisian - -	30/3	"	8/6	8 10†	0 12	7 18	71	2/3	1·20
" Persian - -	31/3	"	8/9	8 15	0 12	8 3	71	2/4	1·25
" Karachi - -	34/3	"	9/7	9 12	0 12	9 0	71	2/6	1·34
Oats, English, White -	—	—	10/4	10 7	0 14	9 13	59·5	3/3	1·74
" Black and Grey	—	—	10/-	10 0	0 14	9 6	59·5	3/2	1·70
" Canadian No. 2	—	—	—	—	—	—	—	—	—
Western	26/3	320	9/2	9 3	0 14	8 9	59·5	2/10	1·52
" No. 3 - -	25/3	"	8/10	8 17	0 14	8 3	59·5	2/9	1·47
" Canadian Feed -	24/-	"	8/5	8 8	0 14	7 14	59·5	2/7	1·38
" Argentine - -	22/-	"	7/8	7 13	0 14	6 19	59·5	2/4	1·25
" Chilean - -	27/3	"	9/6	9 10	0 14	8 16	59·5	2/11	1·56
Maize, American - -	41/6	480	9/8	9 13†	0 13	9 0	81	2/3	1·20
" Argentine - -	42/-	"	9/10	9 17	0 13	9 4	81	2/3	1·20
" Galatz-Foxanian	41/9	"	9/9	9 15†	0 13	9 2	81	2/3	1·20
" Karachi - -	42/6	"	9/11	9 18	0 13	9 5	81	2/3	1·20
Beans, English Winter	—	—	10/7	10 12	1 13	8 19	67	2/8	1·43
" Rangoon - -	—	—	10/-	10 0†	1 13	8 7	67	2/6	1·34
Peas, Japanese - -	—	—	23/9	23 15†	1 9	22 6	69	6/6	3·48
Millers' Offals:—	—	—	—	—	—	—	—	—	—
Bran, British - -	—	—	—	7 17	1 7	6 10	45	2/11	1·56
" Broad - -	—	—	—	8 12	1 7	7 5	45	3/3	1·74
Middlings Fine (Im-	—	—	—	—	—	—	—	—	—
ported)	—	—	—	9 10	1 3	8 7	72	2/4	1·25
" Coarse (British)	—	—	—	8 17	1 3	7 14	64	2/5	1·29
Pollards, Imported -	—	—	—	6 15†	1 7	5 8	60	1/10	0·98
Meal, Barley - -	—	—	—	10 7	0 12	9 15	71	2/9	1·47
" Maize - -	—	—	—	11 10	0 13	10 17	81	2/8	1·43
" Germ - -	—	—	—	9 5	0 19	8 6	85·3	1/11	1·03
" Gluten-feed -	—	—	—	9 7	1 8	7 19	75·6	2/1	1·12
" Locust Bean -	—	—	—	8 5	0 10	7 15	71·4	2/2	1·16
" Bean - -	—	—	—	13 0	1 13	11 7	67	3/5	1·83
" Fish - -	—	—	—	20 0	4 8	15 12	53	5/11	3·17
Linseed - -	—	—	—	19 15	1 12	18 3	119	3/1	1·65
" Cake, English	—	—	—	—	—	—	—	—	—
12% Oil	—	—	—	12 0	1 19	10 1	74	2/9	1·47
" 10% Oil - -	—	—	—	11 5	1 19	9 6	74	2/6	1·34
" 9% Oil - -	—	—	—	11 2	1 19	9 3	74	2/6	1·34
Cottonseed Cake, English	—	—	—	—	—	—	—	—	—
5½% Oil - -	—	—	—	8 5	1 16	6 9	42	3/1	1·65
" Egyptian	—	—	—	—	—	—	—	—	—
5½% Oil	—	—	—	7 17	1 16	6 1	42	2/11	1·56
Decorticated Cotton	—	—	—	—	—	—	—	—	—
Seed Meal 7% Oil -	—	—	—	12 10†	2 16	9 14	71	2/9	1·47
Coconut Cake 6% Oil -	—	—	—	9 5	1 11	7 14	73	2/1	1·12
Palm Kernel Cake 6% Oil	—	—	—	7 0†	1 5	5 15	71·3	1/7	0·85
Feeding Treacle - -	—	—	—	7 5	0 8	6 17	51	2/8	1·43
Brewers' Grains:—	—	—	—	—	—	—	—	—	—
Dried Ale - -	—	—	—	7 15	1 5	6 10	49	2/8	1·43
" Porter - -	—	—	—	7 5	1 5	6 0	49	2/5	1·29
Wet Ale - -	—	—	—	1 14	0 9	1 5	15	1/8	0·89
" Porter - -	—	—	—	1 8	0 9	0 19	15	1/3	0·67
Malt Culms - -	—	—	—	8 0†	1 15	6 5	43	2 11	1 56

† At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of April and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose coconut cake is offered locally at £10 per ton. Its manurial value is £1 11s. per ton. The food value per ton is therefore £8 9s. per ton. Dividing this figure by 73, the starch equivalent of coconut cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 13s. 6d.; P₂O₅, 4s. 1d.; K₂O, 2s. 6d.

LAMBING RECORD.

		Average live lambs per ewe.	Average weight per lamb.
Lot 1	... ..	1·6	8·8 lb.
Lot 2	... ..	1·3	10·3 lb.
Lot 3	... ..	1·6	10·1 lb.
Lot 4	... ..	1·4	9·2 lb.

It will be seen from the above data that all the flocks receiving salt made better gains than the no salt flock, that the lightly salted and medium salted flocks made better gains than the heavily salted flock, that the lightly salted and medium salted ewes produced the best lambs, and finally, that the lambs which showed the largest growth or size at birth were found in the salted flocks.

The practical conclusions to be drawn from the above observations are :—

- (1) That it pays to allow ewes free access to a salt lick.
- (2) That if hand fed, *i.e.*, mixed with food, $\frac{4}{8}$ oz. of salt per day is the right amount per ewe.
- (3) That the quantity of salt required will vary with the nature of the foods fed.

It is suggested that the salt should be kept in boxes to which the ewes have free access, and that these boxes should be protected from the weather.

FARM VALUES.

CROPS.	Market Value per lb. S.E.	Value per unit S.E.	Starch Equivalent per 100 lb.	Food Value per Ton.	Manurial Value per Ton.	Value per Ton on Farm.
	d.	s. d.		£ s.	£ s.	£ s.
Wheat - - - - -	1·20	2 3	71·6	8 1	0 16	8 17
Oats - - - - -	1·20	2 3	59·5	6 14	0 14	7 8
Barley - - - - -	1·20	2 3	71·0	8 0	0 12	8 12
Potatoes - - - - -	1·20	2 3	18·0	2 1	0 4	2 5
Swedes - - - - -	1·20	2 3	7·0	0 16	0 2	0 18
Mangolds - - - - -	1·20	2 3	6·0	0 14	0 3	0 17
Good Meadow Hay - - -	1·43	2 8	31·0	4 3	0 14	4 17
Good Oat Straw - - -	1·43	2 8	17·0	2 5	0 7	2 12
Good Clover Hay - - -	1·43	2 8	32·0	4 5	1 1	5 6
Vetch and Oat Silage - -	1·34	2 6	14·0	1 15	0 7	2 2

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PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	Average Price per ton during week ending May 14th.				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 5	...	13.12	14. 2	18. 3
" " Lime (N. 13 per cent.) ... ..	...	12.10	...	12.10	19. 3
Sulphate of Ammonia, ordinary (N. 20¾ per cent.)	14. 2*	14. 2*	14. 2*	14. 2*	(N)13. 7
" " " neutral (N. 21¼ per cent.)	15. 5*	15. 5*	15. 5*	15. 5*	(N)14. 5
Kainit (Pot. 12¼ per cent.) ... ..	...	...	...	2. 5	3. 7
French Kainit (Pot. 14 per cent.)	2.10	2. 6	2. 5	2.12	3. 9
" " (Pot. 20 per cent.) ... ..	...	2.10	...	2.17	2.10
Potash Salts (Pot. 30 per cent.) ... ..	...	...	...	3.15	2. 6
" " (Pot. 20 per cent.) ... ..	...	...	2.10	2.15	2. 9
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7. 5	7.10	7. 7	2.11
Sulphate of Potash (Pot. 48 per cent.) ...	...	11. 5	11.10	11.10	4. 9
Basic Slag (T.P. 28 per cent.) ... ..	...	2. 4§	...	...	...
" " (T.P. 26 per cent.) ... ..	...	2. 0§	...	...	...
" " (T.P. 24 per cent.) ... ..	...	1.16§	2. 0§	...	...
" " (T.P. 18 per cent.) ... ..	...	...	1.15§	...	...
Superphosphate (S.P. 35 per cent.) ...	4. 4	...	3.15§	3.15	2. 2
" " (S.P. 30 per cent.)	3.16	3. 7	3. 8§	3. 7	2. 3
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9. 0	8.15	8.15	7.17	...
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	6.17	6.15†	6. 0	6. 2†	...
Fish Guano (N. 7½-8½, T.P. 16-20 per cent.)	12.15	...	13.10	...	...
" " (N. 9, T.P. 10 per cent.) ... ..	...	...	...	13. 0	...

Abbreviations: N.=Nitrogen; A.=Ammonia; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire; London prices include delivery within a limited area. Cost to purchasers in other districts will be greater or less according to the distance of different purchasers from the works.

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RESEARCH scholarships in agricultural and veterinary science, of the value of £200 per annum, tenable for three years from 1st October, 1924, will be awarded by the Ministry of Agriculture and Fisheries. Applications must be received by the Ministry not later than 15th July, 1924, and must be made on the prescribed form.

The latter, together with a copy of the conditions attached to the scholarships, may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1. The number of scholarships awarded will not exceed seven.

POULTRY breeders are devoting considerable attention to the influence of the male bird in improving the fecundity of mediocre flocks, there being evidence to show that a cockerel bred from a prolific female transmits the laying powers of his dam to his own female progeny. Schemes to enable poultry keepers to obtain cockerels from a good laying strain are, therefore, being considered in various parts of the country; and it is interesting to note that the Northampton Agricultural Education Sub-Committee has a distribution scheme of this character in preparation. The Cockerel Distribution Scheme of the East Sussex County Agricultural Committee, which has been approved by the Ministry as an experiment, has been organised, however, with a quite different object. Sussex, as a centre for the production of table poultry, is finding that the general concentration on egg production makes it increasingly difficult for breeders there to obtain the class of cockerel they require. The East Sussex Scheme aims, therefore, at the distribution, from each of two selected centres, of 50 approved cockerels which will be suitable as regards breeding and type for improving the class of bird used for fattening purposes. The Scheme which started last month will be in operation up to November next; and the cockerels are intended for distribution to the same class of poultry keepers as is eligible to participate in the Ministry's Egg and Day-Old Chick Distribution Scheme. The birds will be supplied at the following prices:—12 weeks old, 8s.; 18 weeks, 15s.; and 24 weeks, 20s.; a subsidy of 4s. being paid to the station-holders in respect of each cockerel supplied. Further particulars of the scheme can be obtained from the Director of Education, County Hall, Lewes.

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THE Ministry has awarded the following travelling research fellowships to research workers in agricultural science in the current financial year:—

**Travelling
Research
Fellowships in
Agricultural
Science.**

1. A Fellowship of £250 to Mr. F. L. Engledow, of the Cambridge University Plant Breeding Institute, for a visit to the United States to investigate American work on barley genetics, cereal yield testing, and the quality, storage and production of wheat.

2. A Fellowship of £50 to Mr. E. S. Salmon, of the South Eastern Agricultural College, Wye, Kent, for a visit to Czechoslovakia to investigate the growing of hops in that country.

3. A Fellowship of £60 to Dr. A. G. Ruston, of Leeds University, for a visit to Switzerland and Denmark for the purpose of investigations into agricultural costings.

In addition to the above Fellowships the Ministry has also been authorised to award grants for the first time to workers in agricultural science in this country, to enable them to represent Great Britain at International Conferences and Congresses. This new scheme is very welcome in view of the increasingly high reputation which British agricultural research is attaining among workers in other countries. It seems likely that this country will take the position in International Conferences of agricultural scientific workers that was held by Germany before the war. The grants awarded under this scheme in the present financial year are as follows:—

1. *Fourth International Conference of Pedology, Rome, May, 1924.* Grants of £35 to:—

Sir John Russell, Rothamsted Experimental Station.

Dr. B. A. Keen, Rothamsted Experimental Station.

Mr. G. W. Robinson, University College of North Wales.

Dr. N. M. Comber, Agricultural Department, Leeds University.

2. *Second World's Poultry Congress and Exhibition, Barcelona.* A grant of £35 to:—

Professor R. C. Punnett, Department of Genetics, Cambridge University.

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GOAT keepers are informed that a scheme for the payment of premiums on approved stud goats in respect of services of

Stud Goat Scheme.

female goats at a low fee is now in operation under the auspices of the British Goat Society. The scheme has been approved and will be financially assisted by the Ministry. The object of the scheme is to improve by means of breeding the productive quality of milch goats kept by small-holders, cottagers and other persons of a similar position. Stud goats will be registered by the British Goat Society as eligible for premiums under the scheme on the fulfilment of certain specified conditions, particulars of which may be obtained from the Society. The owner of the stud goat need not necessarily be a member of the British Goat Society. A leaflet explaining the scheme

has been issued by the Society, and goat keepers who are interested should apply at once to the British Goat Society, 5, Fenchurch Street, London, E.C.3, for a copy of it and for any further information required. Applications for the registration of stud goats should be made direct to the Society not later than 15th June next.

The Ministry trusts that this scheme may be successful in raising the quality of goats kept by persons of small means. There is room for the extension of goat-keeping in suitable districts; one of the chief drawbacks is that the he-goats used for service are often of indifferent quality owing to the difficulty of obtaining the use of first-class males at low fees. Under the new scheme small goat keepers will have security that an approved stud goat is of high quality, and that female kids from this goat will be well worth rearing. The fee charged must not exceed 5s., and the scheme is open to all those who own female goats, whether members of the British Goat Society or not, provided they come within the category of the small-holder or cottager class.

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THE February issue of the *Monthly Labour Review* of the United States Bureau of Labour Statistics contains an inter-

**Farm Wages
in U.S.A.**

esting table showing the course of farm wages since 1913. It is apparent that economic conditions during the latter years of the war and the period immediately following the Armistice affected the American Continent in much the same way as they did European countries. Wages rose steadily from 1915 onwards, reaching their zenith in 1920, after which a rapid decline is recorded.

The following table shows the percentage increases in the wages of regular farm labourers not boarded on the farm as compared with the year 1914:—

1915	...	0.9	1918	...	63.3	1921	...	45.0
1916	...	9.8	1919	...	88.4	1922	...	39.9
1917	...	35.3	1920	...	117.4	1923	...	57.0

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PRICES of agricultural produce during April were on the average 53 per cent. above those in the corresponding month

**The Agricultural
Index Number.**

of the years 1911-1913, as compared with 57 per cent. in March and 61 per cent. in February. There has thus been a decline of 8 points, or about 5 per cent., in two months, a fall

very similar to that which occurred during the same period last year. Throughout this year, up to the present, prices have been slightly lower on the average than in 1923. The following table shows the percentage increases monthly since January, 1920 :—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911-13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	61
March ...	189	150	77	59	57
April ...	202	149	70	54	53
May ...	180	119	71	54	—
June ...	175	112	68	51	—
July ...	186	112	72	53	—
August ...	193	131	67	54	—
September	202	116	57	56	—
October ...	194	86	59	51	—
November	193	79	62	53	—
December	184	76	59	56	—

There has been a slow but steady advance in wheat prices since early in April and a less pronounced rise in prices of oats, but the rise is insufficient to make up for the fall which occurred during the previous month, and on the average prices were respectively 4d. and 3d. per cwt. lower in April than in March, the corresponding index numbers declining by 8 points and 4 points respectively. Barley moved irregularly, but on the whole was also cheaper by about 2d. per cwt than in March; falling average prices for home-grown barley are, however, usual at this time of the year, and the index number shows a rise of 3 points on the month.

Potatoes hardened in price gradually up to the middle of April, and then rose sharply, prices being 60s. or 70s. per ton higher at the end than at the beginning of the month. On the average of the whole month, however, prices were only about 16s. per ton higher than in March, and as a pronounced rise between March and April occurred in the basic pre-war years, the index number, in spite of the rise in prices, shows a fall of several points. Unless there is a substantial fall in potato prices during this month, however, the index number for potatoes will show a very steep rise in May, as the full effect of the recent advance in prices will be brought into play.

Hay remains at approximately its pre-war level, the slight hardening in prices during April being no more than is customary at this season.

Although cattle prices have shown practically no change from month to month throughout this year, the index number has declined steadily, due to the fact that prices are normally rising during the earlier months of the year. On the other hand, both sheep and pigs show a recovery this month, to about the February level, but they are still much cheaper than at this time last year.

For several months now, many of the store stock markets have been closed owing to foot-and-mouth disease and, although matters have recently improved, the fact that relatively few markets remain open somewhat invalidates the comparison of average prices of store stock with those of more normal times. So far as figures are available it appears that yearling cattle were cheaper in April than in March, but the fall was more than counterbalanced by the advance in the price of 2-year-olds. As store cattle are usually advancing in value at this season, however, the index number shows a slight fall. Similarly with sheep, the index figure is slightly lower in spite of a rise of about 3s. per head in average prices, while store pigs were cheaper, both actually and relatively, in April than in March, probably as a result of the continued depression in the market for fat pigs. Dairy cows have maintained the improvement recorded last month, and during April realised over 60 per cent. more than in pre-war days.

All kinds of poultry rose appreciably in April, and in spite of a normal rise in price before the war, the index number for April is decidedly higher than that for March. Eggs, on the other hand, continued their seasonal decline, and the fall was moreover relatively much greater than in pre-war years, the index number showing a drop of as much as 20 points, making a total fall of 37 points since January.

It is one of the most noticeable features of price movements in recent years, that seasonal fluctuations have been much more pronounced than before the war, in the case of all agricultural products which are subject to seasonal price variations. This is clearly seen in the case of poultry and eggs, and is also apparent in connection with prices of dairy produce. The average price of milk delivered to large towns during April was a fraction below 1s. per gallon, as compared with about 1s. 6 $\frac{3}{4}$ d. during January and February. In pre-war years the summer and winter prices were respectively 7 $\frac{1}{2}$ d. and 10d. per gallon, a much smaller proportionate difference. Hence average prices paid for milk during April were only 58 per cent. above

those paid in the corresponding month in the years 1911-1913, while February prices were 87 per cent. above pre-war. Butter prices have similarly fallen decidedly more than was customary before the war, and at 51 per cent. above the level of April, 1911-1913, are 20 points lower than in February.

Index numbers of different commodities during recent months and in April, 1923, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

Commodity.	1923.		1924.			
	Apr.	Dec.	Jan.	Feb.	Mar.	Apr.
Wheat ...	31	33	34	44	46	38
Barley ...	11	27	34	43	45	48
Oats ...	39	30	38	41	39	35
Fat cattle ...	51	49	56	54	52	49
Fat sheep ...	100	72	87	75	64	75
Fat pigs ...	71	43	43	34	33	35
Dairy cows ...	55	—	51	48	64	63
Store cattle ...	29	—	35	39	41	38
Store sheep ...	92	—	91	89	85	84
Store pigs ...	131	—	63	50	45	42
Eggs... ..	37	86	85	75	68	48
Poultry ...	75	77	60	52	59	70
Milk	70	90	87	87	71	58
Butter	68	68	68	71	63	51
Cheese	92	71	76	72	71	71
Potatoes ...	—28*	91	129	170	173	154
Hay	40	0	—1*	—1*	1	0

* Decrease.

Although on the whole the general level of prices of agricultural produce is little different from that of April last year, there are several changes in individual items which are of interest. Potatoes in April last year sold at nearly 30 per cent. below pre-war rates and are now at about two-and-a-half times pre-war prices. Hay, on the other hand, has fallen to its pre-war level. These changes are directly attributable to fluctuations in supply, the 1923 potato crop in England and Wales being less than 70 per cent. of the previous year's crop, while the hay crop was over 30 per cent. in excess of that of 1922. Apart from these commodities there is a general levelling up of prices. There is now no index number so high as the 100 per cent. excess over pre-war recorded for fat sheep last April, or the 92 per cent. for cheese; nor is there any commodity so cheap in comparison with pre-war as were wheat and barley in April of last year. The extreme range (potatoes and hay excepted) is now from 35 per cent. above pre-war, which is the figure for oats and fat pigs, to 75 per cent., the figure for fat sheep.

THE Minister of Agriculture and Fisheries has appointed a Committee to formulate, for the consideration of his department, a detailed scheme for individual tests of agricultural machinery as recommended by the Machinery Advisory Committee in their Report of 7th April, 1923.

**The Testing of
Agricultural
Machinery.**

The scheme is to include:—

- (a) the general regulations governing the admission of machines and implements for testing;
- (b) the special regulations governing particular groups or classes of machines and implements;
- (c) the forms of entry to be submitted to the Ministry;
- (d) the forms of certificates and reports to be issued by the Ministry;
- (e) the scale of fees to be charged, having regard to the necessity of making the scheme, as far as possible, self-supporting.

The following have been appointed:—

- Mr. W. E. Dalby, F.R.S., Professor of Engineering in the University of London;
- Mr. Thompson Close, of the Ministry of Agriculture and Fisheries;
- Mr. F. S. Courtney, M.I.C.E., M.I.M.E., Consulting Engineer to the Royal Agricultural Society of England;
- Mr. Henry Deck;
- Mr. Harry German;
- Mr. W. Harrison;
- Mr. B. J. Owen, M.Sc., M.Eng., Director of the Institute for Agricultural Engineering, Oxford;
- Mr. T. E. Stanton, C.B.E., D.Sc., F.R.S., of the National Physical Laboratory, Department of Scientific and Industrial Research.

Professor Dalby has been appointed Chairman and Mr. P. Barker, of the Ministry of Agriculture and Fisheries, Secretary of the Committee.

The Committee is empowered to co-opt, for the purpose of inquiry into any particular class or classes of machine or implement, or into any particular form of test, such person or persons whose knowledge may be of assistance.

* * * * *

It will be of interest to dog-owners and the public generally to learn that two cases of rabies have recently (in April) been confirmed by the Ministry in imported dogs whilst undergoing the prescribed quarantine on veterinary premises in accordance with the Ministry's regulations.

**Rabies in
Imported Dogs.**

In one case the dog came from Egypt and the first symptoms appeared three days after arrival at the quarantine

station. From inquiries made it was ascertained that the dog had been used for hunting wild dogs and had been severely bitten about two months before the disease appeared.

In the other case the dog came from India and the first symptoms did not appear until the dog had been three months in quarantine. Allowing for the period of the voyage, this dog must have been bitten, therefore, at least four months before rabies appeared.

* * * * *

THE Fream Memorial Prize, which is annually awarded by the Ministry to the candidate who obtains the highest marks

The Fream Memorial Prize. in the examination for the National Diploma in Agriculture, has been won this year by Mr. Richard W. Thompson, a

student of the Harper Adams Agricultural College. The value of the prize this year is about £7 10s., which is to be devoted to the purchase of books.

* * * * *

THE agreement of the Cheshire Committee, which was due to terminate at the end of April, has been extended up to

Conciliation Committees in Agriculture. 31st October. The rate for adult male workers is 32s. for a week of 54 hours, with all overtime employment payable at the rate of 9d. per hour.

The Carnarvon Committee has decided that the existing agreement, with minor amendments, shall remain in force for the time being. Special class workers of 20 years and over living out receive 35s. for 61 hours per week (to include Sunday feeding and cleaning of stock), and those boarded and lodged on the farm, 33s. 6d. (including the value of board and lodging at the rate of 14s. for seven days, and 12s. for six days). The wages of other adult male workers are 30s. for a 50-hour week, and provision is made for the payment of harvest overtime at the rate of 9d. per hour.

The Denbigh and Flint agreement has been extended from 30th April last to 30th November. The terms provide for the payment of horsemen and stockmen at the rate of 33s. for 61 hours, and of other adult male workers at 27s. 1d. for 50 hours. A weekly half-holiday is recommended.

What amounts to an extension of the last agreement has been made by the Merioneth and Montgomery Committee, and the rates are to continue in operation until 31st October instead of 30th April, as previously. Stockmen are to receive 32s. for a guaranteed week of 60 hours, *i.e.*, an advance of 1s., whereas

the rates for ordinary adult male workers are 30s. for 54 hours, as compared with the former 28s. for 52 hours.

* * * * *

In the House of Commons on 7th May, Mrs. Wintringham asked the Minister of Health whether the reports of his inspectors showed that the public can rely on the high hygienic quality of the large quantities of milk described on sale as nursery, invalids, or guaranteed; and, if not, whether he would consider how the public may be safeguarded in the matter?

**Special Milk
Designations.**

The Minister of Health (Mr. Wheatley) replied: "According to the information in my possession the answer to the first part of the question is 'No.' I will consider what steps it may be practicable to take to safeguard the public in this matter, but in the meantime I think the consumer would be well advised not to place too much reliance on descriptions and designations implying special hygienic qualities other than those authorised by the Milk (Special Designations) Order."

Mrs. Wintringham also asked whether the Minister of Health was aware that a large part of the milk sold as raw milk in our large cities has been pasteurised or otherwise treated by heat; and whether he was prepared to take steps to ensure that purchasers may know whether their milk has been so treated?

Mr. Wheatley replied: "Yes, Sir; and, while I am doubtful whether it will prove practicable to take effective steps in the direction suggested, I will consider the hon. Member's proposal. I am hopeful that the provisions of the Milk (Special Designations) Order, 1923, as to the use of the term 'pasteurised' may contribute to the enlightenment of consumers and lead to the disuse of unapproved processes."

* * * * *

NOTICES OF BOOKS.

The British Goat Society's Year Book for 1924 (Issued by the Hon. Secretary, 5, Fenchurch Street, E.C.3. Price 1s. 6d.) indicates that the Editor continues, with increasing success, to present a budget of information which is both useful and interesting. Doubtless the Year Book eventually reaches a much wider circle of readers than that of the Society's members alone, since the articles are so comprehensive as to provide almost sufficient material for an up-to-date text-book on the subject. The messages from the President, Lord Leverhulme, and the late President, Lord Dewar, show that the principal officers of the Society take more than a passive interest in its work, which is apparently directed, more and more, to the improvement of the cottager's goat, and the encouragement of goat-keeping as a means of supplying goats' milk of the highest quality in the homes of the poorer

people, at low cost. The article on intensive goat-keeping for the cottager should be of value to the many people who would like to keep milch goats but who are under the erroneous impression that considerable land for the animals to roam over is essential. The article on butter-making and cheese-making from goats' milk should enable many goat-keepers economically to utilise their surplus milk in the flush season. The scientific side of goat-keeping has not been neglected, and an article on genetics by Dr. Crew and another on skin diseases by Mr. H. Stainton are included.

Among the excellent photographs of goats is shown one of the Toggenburg stud goats imported in 1921, and two of his progeny. This successful importation is only one indication of the comprehensive policy adopted by the British Goat Society, which is now about to put into operation, with the approval and financial aid of the Ministry of Agriculture, a scheme for the provision of stud goats of good quality in England and Wales, for the benefit of the poorer goat-keepers. Already a number of the Society's members who breed high-class pedigree goats are members of the Ministry's Milk Recording Societies, and thus obtain reliable records of the individual milk yields of their goats. The aims of the British Goat Society, its constitution and rules, are set out in the Year Book, which altogether forms a most valuable book of reference for goat-keepers.

Profitable Poultry.—(E. Bostock Smith. London : The City and South London Printing and Publishing Co., Ltd. Price 1s.) This small book contains a good account of the Heaselands Poultry Farm and much sound practical advice. The photographs are excellent and illustrate not only the stock kept and the methods adopted at Heaselands, but incidentally depict some of the natural beauty of that district of Sussex. To those persons who are unfamiliar with modern poultry farms and who are considering the possibility of engaging in the industry, this book presents much interesting material, both from the technical and business standpoint. The author introduces so many sound business maxims with his book that its readers will no doubt understand that he has practised what he preaches, and that at Heaselands Poultry Farm efficient business methods are adopted.

The working drawings of poultry houses which are included in the book constitute a most useful amplification of the photographs, and will no doubt be much appreciated by those who prefer to build houses of the Heaselands type.

Diseases of Glasshouse Plants.—(W. F. Bewley, D.Sc., London : Ernest Benn, Limited, 1923, 208 pp., 12s. 6d. net.) The main object of this book, as is stated in its preface, is to provide for growers of crops under glass an account of the fundamental principles on which the control of disease in such crops is based. The book is intended to be of practical use to growers in the course of their business, and it may be stated that no one is more competent to write with knowledge and experience on this subject than the author, who is the well-known Director of the Experimental and Research Station of the Nursery and Market Garden Industries' Development Society, Ltd., at Cheshunt, Herts.

The first part of the book, which comprises the first two chapters, deals with the general conditions which govern cultivation under glass, and with the relation of these conditions to plant hygiene and to the incidence of disease. It is shown not only how maladjustment of such

environmental factors as light, temperature, moisture, etc., may result directly in unhealthiness or disease in the crop in the absence of any specific organism, but also how these factors may play a most important part in deciding whether or not infection with a parasite may occur and, if so, to what degree its ravages may extend. Two illustrative examples may be referred to here. Cucumbers grown in a house in which the soil temperature is low whilst that of the atmosphere is high are apt to wilt and die because the activity of the roots in the cool soil is not great enough to secure a supply of moisture sufficient to replace that transpired from the foliage. Again, in the case of tomatoes, unless soil temperature is maintained at or about 29°C. the wilt-producing fungus, *Fusarium lycopersici*, does not succeed in infecting the roots. These diseases, therefore, can be controlled by proper attention to the temperature factor.

Three chapters follow in which diseases due to specific pathogenic fungi are dealt with, and recommendations for their treatment are laid down. They are classified under the headings: (a) Root Diseases, (b) Wilt Diseases, and (c) Stem, Leaf and Fruit Diseases, and the principal hosts involved are the tomato, cucumber and melon, as well as the carnation, sweet pea and chrysanthemum. Space does not permit of detailed reference to individual diseases and the methods of controlling them, but mention may be made of a valuable method of dealing with the "damping off" disease of seedlings. This consists in watering the soil with "Cheshunt Compound," which is prepared by intimately mixing copper sulphate and ammonium carbonate in certain proportions and making a dilute solution of the resulting powder in water just before use. Although this treatment does not secure the recovery of seedlings already attacked, it does prevent the infection of further seedlings; and if applied to the soil after sowing and covering the seeds, it secures immunity for the seedlings when they arise.

In Chapter VI the more important diseases of glasshouse crops which are caused by bacteria are described. These include the cucumber "wilt" due to *Bacillus tracheiphilus*, a "foot-rot" of the cucumber and melon due to *B. carotovorus*, the "angular leaf-spot" of the cucumber, "stripe" disease of tomato, sweet pea, etc., and some others. Measures for control are also suggested. A good account of the so-called "mosaic" or "virus" diseases of the tomato and the cucumber is given and their infectious nature and mode of transmission explained.

The concluding chapters of the book are concerned with general reflections and considerations on disease treatment. The importance of water and soil sterilization is pointed out and practical details in connection with the carrying out of these processes are supplied. Useful information on spraying and dusting with the more important fungicides is given, and the methods of cleansing glasshouses are briefly described. The possibilities of breeding, selection and hybridization in regard to the production of resistant varieties are alluded to, and instances of success in this field of work given.

In an Appendix a list of diseases of the tomato is given, in which they are grouped according to whether they are common in England or only occasionally found here. There is added, in the form of a bibliography, a list of the original publications, which are referred to in the text.

The book is illustrated with nearly fifty figures, many of which take the form of well executed half-tone reproductions of photographs of typically diseased plants.

As already stated, the book is primarily intended for the grower, and it is therefore not overburdened with technical mycological descriptions and details. Nevertheless, not only the grower, but also the plant pathologist, may profit by a study of its pages.

Manuring of Market Garden Crops.—(Bernard Dyer, D.Sc., and F. W. E. Shrivell. London: G. Street & Co., Ltd. Price 1s. post free.) This is in the main a reprint of the volume published by Dr. Dyer and Mr. Shrivell, giving the results they obtained in manuring market garden crops on a poor clay loam soil at Hadlow, with the addition of two further years' results. These experiments provide a useful guide to the market gardener who is fortunate enough to be able to maintain a reasonable supply of dung to his land, but, with the exception of a few crops, are of little value where only very small supplies of dung are available.

An interesting feature is the addition of tables showing the results of growing certain vegetable crops without manure on the plots which had previously been manured in different ways. In general, both the plots which had received heavy annual dressings of dung, and those which had received light dressings of dung supplemented by fertilisers, gave two good crops—in the case of broccoli three—rather below the previous manured crops, and then fell off rapidly. Exceptionally beet, carrots and, possibly, parsnips, yielded as well in the fourth year as in the first, especially where the annual dressing of nitrate of soda had been as heavy as 6 cwt. per acre. An interesting sidelight is thrown on the use of potash. In the case of such potash-loving crops as the roots mentioned above, the residue of potash has proved beneficial where 2 cwt., or even 4 cwt., of nitrate of soda had been used, but was of no value, or was even harmful, where 6 cwt. had been used in conjunction with other fertilisers and dung. The results make it abundantly clear that while mineral fertilisers do not impoverish the land so much as is commonly supposed, yet their use cannot profitably be continued, for most crops, in the absence of dung or, presumably, some humus-forming equivalent.

Plants Poisonous to Live Stock.—(Harold C. Long. Cambridge and London: University Press. Price 8s. 6d.) This volume contains information on all flowering plants likely to prove poisonous to live stock on farms in the United Kingdom. The author states that "as in the case of a previous volume, *Common Weeds of the Farm and Garden*, the preparation of this handbook was undertaken because of the great lack of readily available and reliable information on the subject in English scientific literature," and, further, that "an endeavour has been made to give a sound but brief statement as to the present information on plants poisonous to live stock in the United Kingdom." Symptoms, toxic principles and many references to the literature on the subject are given in the case of almost every plant covered. The text relating to a number of species has been much amended since the earlier edition was published in 1917. A bibliography contains 267 numbered references.

The Resources of the British Empire: Food Supplies.—(Prof. J. R. Ainsworth-Davis. Part I: Crops and Fruit. Part II: Meat, Fish and Dairy Produce. London: E. Benn, Ltd., 1924. 21s. each volume.) These two volumes, part of a series of twelve prepared by

the Federation of British Industries, provide a valuable survey of the varied products derived from plants and animals. The principle adopted in the preparation of the series has been to combine information of practical value to business men. A considerable portion of the matter is necessarily statistical, but the explanatory passages and general summaries from the pen of so well known a writer as Professor Ainsworth-Davis make the volumes worthy of attention by all who are interested in the production and distribution of food products.

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QUESTIONS IN PARLIAMENT.

Land Drainage and Water Supply Schemes.—In reply to a question asked by Captain Terrell in the House of Commons on 5th May, as to whether the £100,000 promised towards land drainage and afforestation had been paid or promised, wholly or in part, the Minister of Agriculture, Mr. Noel Buxton, said that he presumed the reference was to the extra £105,000 allocated by the present Government to unemployment relief works during the expiring winter season of 1923-24, of which £60,000 was earmarked for land drainage and water supply schemes in England and Wales additional to the £250,000 already voted for that purpose. Completed schemes or schemes still in operation are estimated to absorb nearly £276,000 of this amount, and but for bad weather the whole £310,000 would undoubtedly have been expended.

Wages of Agricultural Workers.—In the House of Commons on the 12th May, Mr. Lambert asked the Minister of Agriculture if he would give particulars of the circumstances where an inspector of the Board found that two agricultural workers were working 63 hours and 53 hours per week for a wage of 20s., and where one labourer was receiving 17s. per week?

Mr. W. R. Smith, Parliamentary Secretary to the Ministry of Agriculture, replied that in one case the man was a farm worker and milker working 62 hours a week, including Sundays, and in the second he was a general farm labourer working 52 hours per week. Both these men were able-bodied and married. No details were available of the circumstances relating to the man who is receiving 17s. per week, as he was not among those interviewed personally by the Ministry's inspector.

* * * * *

Foot-and-Mouth Disease.—The position continues satisfactory, the numbers of outbreaks during the weeks ended 4th, 11th, and 18th May being 9, 11 and 13 respectively, occurring in the following counties, viz.:—

Beds. ... 1	Norfolk ... 1	Yorks. W.R. ... 1
Denbigh ... 1	Northumberland ... 6	Yorks. N.R. ... 2
Lancs. ... 2	Notts. ... 1	Ayr ... 2
Leics. ... 2	Salop ... 3	Perth ... 1
Lincs. Kest- even ... 1	Staffs. ... 3	Renfrew ... 1
	Warwick ... 4	

Of these outbreaks, those at Oswestry on 2nd May, Stotfold, Beds., on 3rd May, Sheffield on 5th May, Willoughby, Rugby, on 8th May, and Ponteland, Northumberland, on 12th May, and Grantham, Kesteven, on 17th May, all necessitated the extension of the areas under restrictions in the respective districts, whilst that at Arngask, Perth, which occurred on the 13th May, occurred on premises on which

an outbreak had previously been dealt with by isolation. In this case the last arrival on the premises had recovered from the disease on 7th December, and restrictions were withdrawn on 14th March. The animal now affected did not take the disease on the previous occasion.

The number of outbreaks from the commencement of the outbreak on 27th August to 18th May is 3,087, involving the slaughter of 103,923 cattle, 43,578 sheep, 47,986 pigs and 128 goats, and the payment of approximately £3,292,000 in compensation.

Leaflets issued by the Ministry.—Since the date of the list given on pages 205-206 of the May issue of the *Journal*, the following leaflets have been issued:—

Revised, No. 112.—Weeds and their Suppression.

No. 202.—The Frit Fly.

No. 265.—Rabbit Keeping.

Re-written, No. 31.—The Onion Fly.

French Colonial Exhibition at Strasbourg.—An industrial and agricultural exhibition will open at Strasbourg on 1st July next. The main object of the exhibition is to display the products that the French colonies can supply to the mother country, and those that home industry and commerce can furnish for export in return. Another section will contain a special exhibit of the products of Alsace and Lorraine.

The agricultural classes will contain exhibits of agricultural, horticultural and forest produce of France and the French colonies, comprising food products, tropical produce such as coffee, cocoa, etc., raw materials for manufacture such as rubber and cotton, machinery and equipment.

ADDITIONS TO THE LIBRARY.

[Readers of the JOURNAL who are not aware that certain books and agricultural periodicals may be borrowed from the Ministry's Library should write to the Ministry for particulars and conditions of loan.]

Field Crops.

University College of North Wales.—Varieties of Oats, 1923. (11 pp.) Bangor, 1924. [63.314.]

University College of North Wales.—Experiments with Potatoes, 1919-1923. (16 pp.) Bangor, 1924. [63.512.]

Welsh Plant Breeding Station.—Series H, No. 2:—The Artificial Hybridisation of Grasses, T. J. Jenkin. (18 pp.) Aberystwyth: University College of Wales, 1924, 3s. 6d. [63.33; 63.1952.]

Kentucky Agricultural Experiment Station.—Circular 29:—Self-Fertility in Red Clover: A Report of Progress on an attempt to secure Self-Fertile Lines in this Crop. (20 pp.) Lexington, 1922. [63.33(b).]

Horticulture and Fruit Growing.

Macself, A. J.—Grass for Ornamental Lawns and all purposes of Sports and Games. (204 pp.) London: Cecil Palmer, 1924, 15s. net. [63.53(02).]

Rowles, W. F.—Greenhouses: How to Make and Manage Them. (124 pp.) London: C. A. Pearson, Ltd., 1924, 1s. 6d. net. [69: 63.5-19.]

Udale, J.—The Handy Book of Pruning, Grafting and Budding. Sixth Edition. (146 pp.) London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd., 1924, 2s. net. [63.41-195.]

Michigan Agricultural Experiment Station.—Special Bulletin 127:—Nitrogen-Carrying Fertilizers and the Bearing Habits of Mature Apple Trees. (32 pp.) East Lansing, 1924. [63.41(a).]

Plant Pests and Diseases.

International Conference of Phytopathology and Economic Entomology, Holland, 1923.—Report. (290 pp. and 16 plates.) Wageningen: T. A. C. Schoevers, Committee of Management. [63.2(02).]

- Kansas Agricultural Experiment Station.*—Bulletin 231 :—Potato Diseases Control in Kansas. (45 pp.) Manhattan, 1924. [63.24-33.]
- U.S. Department of Agriculture.*—Farmers' Bulletin 1367 :—Control of Potato Tuber Diseases. (37 pp.) Washington, 1924. [63.24-33.]
- Live Stock.**
- Lancashire County Council, Education Committee, Agricultural Department.*—Farmers' Bulletin 39 :—Report on Pig-Feeding Trials, 1920-23. (28 pp.) Preston, 1924, 1s. [63.64 : 043.]
- Tod, W. M.*—Hints on Feeding: A Practical Book on the Feeding of Livestock for the Farmer, Dairyman and Pig-Keeper. Second Edition. (300 pp.) London: Macdonald & Martin, 1924, 7s. 6d. [63.6043(02).]
- Veterinary Science.**
- Long, H. C.*—Plants Poisonous to Live Stock. Second Edition Revised. (120 pp.) Cambridge: University Press, 1924, 8s. 6d. net. [619(02): 63.255(02).]
- Bees.**
- U.S. Department of Agriculture.*—Department Bulletin 1222 :—Growth and Feeding of Honey-bee Larvæ. (37 pp.) Washington, 1924. [63.81.]
- Engineering.**
- Kranich, F. N. G.*—Farm Equipment for Mechanical Power. (420 pp.) New York and London: Macmillan Co., 1923, 12s. 6d. net. [63.17(02).]
- Crabbe, E.*—The Handy Man on the Holding. (125 pp.) London: C. A. Pearson, Ltd., 1924, 1s. 6d. net. [62(02) 69(02).]
- Economics.**
- Ainsworth-Davis, J. R.*—Food Supplies. Part I: Crops and Fruit. Part II: Meat, Fish, and Dairy Produce. (*The Resources of the Empire Series.*) London: Ernest Benn, Ltd., 1924, 21s. net each volume. [31; 338.9.]
- Independent Labour Party.*—A Socialist Policy for Agriculture. (32 pp.) London: I. L. P. Information Committee, 1924, 6d. [338.98.]

SELECTED CONTENTS OF PERIODICALS.

Agriculture, General and Miscellaneous.

- The Liming of Land, *J. Augustus Voelcker* (Jour. Farmers' Club, March, 1924, pp. 19-38.) [63.15.]
- Tar, Smoke, and Coal Gas as Factors inimical to Vegetation, *J. H. Priestley*. (Science Progress, XVIII (1924), No. 72, pp. 587-596.) [614.7.]

Field Crops.

- Modern Wheats, *R. H. Biffen*. (Jour. Farmers' Club, 1924, Part I, pp. 1-18.) [63.311.]
- Methods now in Use in Cereal Breeding and Testing at the Cornell Agricultural Experiment Station, *H. H. Love and W. T. Craig*. (Jour. Amer. Soc. Agron., XVI (1924), 2, pp. 109-127.) [63.195; 63.31.]
- Investigations on Yield in the Cereals, I, Part II (*continued*), *F. L. Engledow and S. M. Wadham*. (Jour. Agr. Sci., XIV, 2, April, 1924, pp. 287-324.) [63.31.]
- Field Experiments in Electro-Culture, *V. H. Blackman*. (Jour. Agr. Sci., XIV, 2, April, 1924, pp. 240-267.) [537.]
- Pot Culture Experiments with an Electric Discharge, *V. H. Blackman and A. T. Legg*. (Jour. Agr. Sci., XIV, 2, April, 1924, pp. 268-286.) [537.]

Live Stock.

- Iron Deficiency in Pigs, *J. P. McGowan and A. Crichton*. (Biochem. Jour., XVIII (1924), 1, pp. 265-272.) [612.394.]
- Praktische Fütterungsversuche mit Schweinen über die Wirkung von Fischmel im Vergleiche zu anderen eiweissreichen Futtermitteln, *J. Landis*. (Landw. Jahrb. Schweiz, 1923, eft 5, pp. 595-644.) [63.64 : 043.]

Economics.

- Agricultural Production in Denmark, *H. Faber*. (Jour. Roy. Stat. Soc., Jan., 1924, pp. 22-75.) [63(489); 31(489).]

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NOTES FOR THE MONTH.

THE Agricultural Tribunal consisting of Professor W. G. S. Adams, Sir William Ashley and Professor D. H. MacGregor, with Mr. C. S. Orwin as Agricultural Assessor, and Mr. D. B. Tovey as Secretary, has issued its Final Report.* The terms of reference to the Tribunal were as follows :—

**Agricultural
Tribunal of
Investigation—
Final Report.**

“To inquire into the methods which have been adopted in other countries during the last fifty years to increase the prosperity of agriculture and to secure the fullest possible use of the land for the production of food and the employment of labour at a living wage, and to advise as to the methods by which those results can be achieved in this country.”

Interim reports were issued on 29th March, 1923, and 10th November, 1923, respectively. The Final Report comprises two separate reports, the one by Professor Adams and Sir William Ashley, and the other by Professor MacGregor. The Tribunal point out in their covering letter that while on some matters the two Reports represent different points of view, they should also be regarded largely as supplementary one to the other, each Report treating certain aspects of the problem more fully than the other.

The report by Professor Adams and Sir William Ashley, in comparing British with Foreign agriculture, draws attention to the remarkable decline which has taken place in this country in

* Obtainable from H.M. Stationery Office, Kingsway, W.C. Cmd. 2145; price 5s.

the last fifty years in cereal crops and in roots. In foreign countries there has been on the whole an increase in the arable areas; at least it has been maintained. With regard to employment in agriculture, there has been a relative decline in agricultural employment in all countries and in Great Britain the absolute decline has been greater than in other European countries. The wages of agricultural labour in Great Britain were before the War, and still are, higher than in most European countries. The Members of the Tribunal do not consider, however, that the better position of the agricultural worker in this country is any argument against the re-establishment of Wages Boards; in fact they state that it is only by increasing the wages of agricultural labourers and improving their housing conditions that it will be possible to stop the rural migration, whether to the towns or to the Colonies. They therefore recommend that District Wages Committees should be instituted on the lines recommended in the First Interim Report, and that consideration should be given to the possibility of making special grants in aid of the housing of agricultural workers.

With regard to tenure, it is suggested that the Government should institute an inquiry into the possibility of the extension of the "Evesham Custom" to all agricultural tenancies.

The Report observes that nothing stands out more markedly in a comparison of British and foreign agriculture than the backwardness of co-operation in this country. It is true that in distant countries relying on export to foreign markets a special incentive is upon the farmer to co-operate, but this will not account for the backwardness of England. It recommends that the Government should continue to provide funds for propaganda in aid of co-operation.

With respect to credit, it is suggested that Farm Loan Boards should be established, enjoying defined autonomy up to prescribed financial limits and that these Boards should be the authority responsible for assistance to co-operative societies within their district. The Report states that the Tribunal are satisfied that the time has come for a fresh and large effort to be made to extend small holdings, and Professor Macgregor, in his Report, indicates a scheme which might now be put into operation.

Other recommendations cover agricultural education and research (for which it is suggested that more funds should be

made available), co-operative insurance, administrative organisation and the Councils of Agriculture, and experiments in arable stock farming.

Finally, the Adams-Ashley Report observes that under Free Trade Great Britain can only maintain its arable area by going over to arable stock farming, and this, under present conditions, English farmers have no pecuniary inducement to do, as they can make farming pay by laying down their land to grass. It is recommended, therefore, that the Government should undertake experiments on a large scale to demonstrate whether arable stock farming in this country can be a financial success.

The report by Professor MacGregor observes that there is no ground for depreciation of British agriculture as a whole, in view especially of the great development of our manufactures. British agriculture does not suffer by an international comparison of existing efficiencies with respect to either (a) the actual produce of the soil, or (b) the level of wages paid. The fundamental difference between British and foreign agriculture is not the efficiency but the size of this industry in relation to all industries. Lines of agricultural policy which might be pursued are then indicated.

The maintenance of arable cultivation will increase the opportunity of employment in agriculture, but its expense could not be justified on this ground alone, but only by exigencies of defence. If the Government is not advised that there is an exigency which justifies a heavy annual charge in favour of arable farming the whole argument disappears.

The experience of European countries with a national economy similar to our own, shows the difficulty of maintaining agricultural employment even where strong measures of protection are added on to a system of high organisation. Is the possibility of a decline to a million men and between 30 and 40 per cent. of arable land already so serious that the gradient should be lessened *now* at the cost of a battleship per annum? Or is a home agriculture of this size and form, in relation to our shipping and colonial assets, an adequate basis to work from? If no present urgency is pressed on the Government by its military advisers, then alternatively either 12 million acres of arable, or a million men over 15 employed, might, it is suggested, be taken by agreement of parties as a definite occasion for consideration of the defence problem involved.

At the present time a very considerable sum of the taxpayers' money is spent annually on the prosecution of research in many branches of agriculture and agricultural science. It is generally admitted that this research has resulted in many important additions to knowledge which, however, do not find their way into general agricultural practice as quickly as is desirable. It is indeed contended with some justice that the chief defect in our present system is the insufficiency of the connecting links between the research worker and the practical farmer.

**Conference of
County
Agricultural
Organisers at
Cambridge.**

On the suggestion of the Directors of the Cambridge University Animal Nutrition Research Institute it has been decided to make an attempt to forge another link by holding in Cambridge during the week beginning on 21st July next a Conference of County Organisers and possibly others interested in the rationing of animals. Each day of the Conference a discussion will be initiated on one of the branches of animal feeding by someone who has carried out research on the subject. It is hoped that the various subjects will be thoroughly debated in the light of recent research work and that the debate may result in arrangements being made for the carrying out of joint demonstrations at several widely scattered centres with the object of testing in practice the views propounded by research workers. It is thought that a Conference conducted in this way may do much to spread the results of recent research in nutrition to live-stock owners through the proper channel—the County Organisers.

The programme of the Conference is not yet complete, but it is hoped that Professor T. B. Wood will introduce the subject of the basis of rationing: that Mr. James Mackintosh, of Reading, will open a discussion on rationing milch cows: that Dr. F. H. A. Marshall, of Cambridge, will speak on causes of sterility in farm animals: that Dr. J. B. Orr, Director of the Rowett Research Institute, Aberdeen, will give an account of his work on the mineral requirements of animals: and that Dr. C. Crowther, of the Harper Adams College, will deal with the feeding of young pigs. Arrangements for the Conference are in the hands of Professor Wood, School of Agriculture, Cambridge, Director of the Animal Nutrition Research Institute.

THE Minister of Agriculture and Fisheries has appointed a Standing Committee to advise as to the administration of any public monies that may be made available for the assistance of Agricultural Co-operation or Credit. The Committee is constituted as follows:—Mr. G. M. Gillett, M.P., The Rt. Hon. F. D. Acland, M.P.,

**Committee on
Agricultural
Co-operation
and Credit.**

Mr. A. W. Ashby, Mr. G. W. Brooks, Alderman Mervyn T. Davies, Sir Basil Mayhew, K.B.E., and Mr. T. H. Ryland. Mr. G. M. Gillett, M.P., has been appointed Chairman and Mr. B. W. Phillips, of the Ministry of Agriculture and Fisheries, Secretary to the Committee.

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THE Wart Disease of Potatoes Order of 1923 has now been in force for over twelve months, and while this period is obviously too short to enable any definite opinion to be expressed as to the efficacy of the Order in preventing the spread of the disease, there is every reason to believe that its object has been appreciated

**Movement of
Potatoes from
Wart Disease
Infected Areas.**

generally by potato growers throughout the country, with the result that the requirements of the Order have in most cases been carefully observed.

It appears desirable, however, at this stage to emphasize the particular clause which provides that no potatoes grown in an infected area may be moved or consigned to any place in England and Wales which is not in an infected area. This clause applies to all classes of potatoes whether first or second early and whether intended for seed or for consumption. The only exception is that of ware potatoes of approved immune varieties, and these must be accompanied by a statement to the effect that they are of an approved immune variety and that they were grown in an infected area.

Infringements of this Article of the Order have been known to occur, and in two cases the Ministry has recently instituted legal proceedings which have resulted in the conviction of the defendants, with fines and costs in each case.

The question was recently raised as to whether any exception to this rule could be made in order to allow first early varieties grown in the infected area in South Lancashire to be sent for consumption to large towns in Northern Lancashire and the West Riding of Yorkshire. The matter was referred to the Ministry's Potato Advisory Committee, composed of representatives of all the various branches of the potato industry,

who were unanimous in recommending that no exceptions should be made, and that the Order as it stands should be rigorously enforced.

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THE Ministry's annual report on the prices and supplies of agricultural produce and requirements is now in the press, and will be issued almost at once.

**Prices and Supplies
of Agricultural
Produce and
Requirements in
1923-1924.**

The report reviews the price movements of the different commodities during 1923 and compares prices over a series of years. This review shows that, although as regards some classes of agricultural produce there were sharp increases and with others appreciable reductions in prices during the past year, on the average the rapid decline which was such a serious feature of 1921 and less markedly of 1922 has in the main given place to a gradual and fluctuating movement, which, though still showing some tendency downward, appears to have lost its momentum. The report compares the increase over pre-war in the prices of agricultural produce with the increases in the case of farmers' requirements, such as feeding stuffs, fertilisers, and seeds, and it is found that, as compared with pre-war, the prices of these commodities have been relatively lower during the past year than those of agricultural produce. Changes in wages since 1914 are also reviewed. The various index numbers of prices of agricultural produce, of agricultural requirements, and of rates of wages, indicate that the farmer during the 7 months September, 1923, to March, 1924, and to some extent during the 18 months ending March, 1924, has had a measure of stability in his industry which compares very favourably with the period 1921-22:

Owing to the change in the statistics of imports and exports which took effect on 1st April, 1923, as a result of the taking over as from that date by the Authorities of the Irish Free State of the administration of the Customs in Southern Ireland, it has not been possible to give in detail a comparison of the home production and imports of the different agricultural products in 1923. The information which is available is given and, wherever possible, comparisons are made with previous years.

The report also contains a review of the position as regards the provision at markets of facilities for the weighing of live-stock, and of the extent to which weighing is undertaken.

The report, which forms Part III of the Agricultural Statistics, 1923, is published by H.M. Stationery Office, and may be purchased through any bookseller, price 1s., or direct from H.M.

Stationery Office, Imperial House, Kingsway, London, W.C.2, price 1s. 1d., post free.

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It has been reported to the Ministry that potato blight has made an early appearance amongst crops, and immediate spray-

Spraying Potatoes ing with Bordeaux or Burgundy mixture is
against Blight. advised. If heavy rain washes the spray

from the leaves the operation should be repeated at once. Full directions for spraying are contained in Leaflet No. 23, which can be obtained from the Ministry, 10, Whitehall Place, London, S.W.1.

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AFTER falling by 8 points between January and April the index number representing prices of agricultural produce rose

**Agricultural
Index Number.**

by 3 points in May, the general average of prices over the whole month showing an excess of 56 per cent. over those in the corresponding month in the years 1911 to 1913. In May, 1923, prices were 54 per cent. above pre-war; thus the general price level is now slightly higher than a year ago, but the difference between the two years remains very slight.

In the following table are shown the percentage excesses over pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911-13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	61
March ...	189	150	77	59	57
April ...	202	149	70	54	53
May ...	180	119	71	54	56
June ...	175	112	68	51	—
July ...	186	112	72	53	—
August ...	193	131	67	54	—
September	202	116	57	56	—
October ...	194	86	59	51	—
November	193	79	62	53	—
December	184	76	59	56	—

Both wheat and oats realised higher prices in May than in April, but as a substantial advance was recorded between April and May in the basic years 1911 to 1913, the index number for wheat remains unchanged, while oats, which were only slightly dearer in May than in April, show a fall of 5 points. Barley was slightly cheaper on the month, and the index number for May is 2 points lower than that for April. Barley remains, however, decidedly the dearest of the three main cereals in comparison with pre-war prices.

Potatoes rose sharply between mid-April and mid-May, and although during the latter half of May a fall occurred, the average over the whole of the month, £14 5s. per ton, was £2 15s. per ton higher than in April, while the index number shows a rise of no less than 65 points on the month. In May last year potatoes were making only 72 per cent. of their pre-war value; thus, prices during the past month have been some four and a half times those realised last year.

Hay has again increased in price to a slight extent, and since the normal course of prices at this season is slightly downward, the index number shows an appreciable advance. At the same time, prices are only very slightly above pre-war.

Fat cattle were rather dearer in May than in April, and as the advance was sharper than usually occurs at this season, the index number shows a slight recovery from the decline which had continued without previous interruption since the beginning of the year. Fat sheep are unchanged in price on the month, but the index number shows a substantial advance owing to a fall in the average price between April and May in the basic years. Fat pigs, especially porkers, have again fallen in price, and the index number has declined 3 points on the month.

Store stock prices have followed much the same course as fat stock, cattle and sheep advancing and pigs declining. As more markets are released from the restrictions imposed by the outbreaks of foot-and-mouth disease, the average prices on which the index numbers for store stock are based become more representative of the trade of the whole country, but many markets are still closed and the figures relating to store stock should therefore be accepted with caution.

Poultry shows a further advance, but eggs, although a shade dearer, have risen by less than is usual at this season, and the index number is consequently lower by 8 points.

There was a slight reduction between April and May in the price paid to farmers for milk delivered to some northern and midland towns, and the average over all is now $11\frac{1}{4}$ d.; the index number has fallen correspondingly, May milk prices being 50 per cent. above pre-war. Butter has also fallen considerably, and in spite of a normal seasonal fall, the index number has dropped 11 points, making a total fall of 31 points since February. Cheese, on the other hand, maintains its value, and the monthly average has remained practically unchanged throughout the year up to the present.

Index numbers of different commodities during recent months and in May, 1923, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

Commodity.	1923.	1924.				
	May.	Jan.	Feb.	Mar.	Apr.	May.
Wheat ...	37	34	44	46	38	38
Barley ...	16	34	43	45	48	46
Oats ...	42	38	41	39	35	30
Fat cattle ...	53	56	54	52	49	51
Fat sheep ...	103	87	75	64	75	87
Fat pigs ..	72	43	34	33	35	32
Dairy cows ...	50	51	48	64	63	58
Store cattle ...	33	35	39	41	38	42
Store sheep ...	98	91	89	85	84	96
Store pigs ...	126	63	50	45	42	36
Eggs... ..	43	85	75	68	48	40
Poultry ...	77	60	52	59	70	87
Milk	63	87	87	71	58	50
Butter ...	40	68	71	63	51	40
Cheese ...	42	76	72	71	71	77
Potatoes ...	—28*	129	170	173	154	219
Hay	41	—1*	—1*	1	0	4

* Decrease.

It is of interest to note that the rise of 3 points this month is due to the abrupt rise in potato prices. Were it not for this rise, the general index number would have been unchanged on the month, or even fractionally lower.

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THE agreement of the Cumberland and Westmorland Committee, which was due to expire on 7th June, has been

**Conciliation
Committees
in Agriculture.** extended to 11th November. The terms provide for the payment of skilled male workers at the rate of 37s. for customary hours (about 63 per week), and of other adult male workers at 30s. for a week of 54 hours in summer and 48 in winter.

The Lancashire Committee's agreement has been extended to 31st October. The rates are:—*Southern Area*: Special class workers, 35s. for customary hours; other workers, 32s. 6d. *Northern Area*: Special class workers, 37s. 6d. for customary hours; other workers, 35s. *Eastern Area*: Special class workers, 40s. for customary hours.

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COUNTY AGRICULTURAL COMMITTEES AND AGRICULTURAL DEVELOPMENT.

THE Minister of Agriculture and Fisheries, the Rt. Hon. Noel Buxton, M.P., has had under consideration the question whether the Agricultural Committees of the County Councils might not with advantage play a larger part in the agricultural development of the country than has hitherto been the case.

The Agricultural Committees were established by the Ministry of Agriculture and Fisheries Act, 1919, on the recommendation of Lord Selborne's Committee on Agricultural Policy, to administer the powers of control of cultivation which were contained in the Corn Production Acts and to co-ordinate all the agricultural work for which the County Councils were responsible, such as the provision of small holdings, the local administration of the Diseases of Animals Acts, and, if the County Council so decided, the responsibility for agricultural education. The Committees were also made the constituent bodies for the appointment of a majority of the Councils of Agriculture for England and for Wales.

Soon after the Agricultural Committees were first established an important part of the duties for which they were responsible came to an end by the repeal of the Corn Production Acts, and this has undoubtedly had a detrimental effect on the interests and activities of the Committees, so much so that representations have been made to the Ministry from several counties that in the altered circumstances the Agricultural Committees cannot be of any practical use and should be abolished.

This proposal, however, appears to the Minister to ignore one of the main reasons for the establishment of these Committees in a country which is so predominantly industrial as ours. No means should be neglected which may enlist the interest of the general population in agricultural problems and difficulties; one way of attaining this end is to associate agriculture with the sphere of local government and to set up an authority in each county on which agriculturists, in conjunction with members of other industries, can work together to promote agricultural development in the interests of the whole community. It would have been, and would now be, a great mistake if the recognised organisation of local government did not include a regularly constituted body competent and empowered to speak for agriculture in each county.

That consideration still holds good and justifies the maintenance of the Agricultural Committees. Their abolition would, in the Minister's view, be a retrograde step. The right course is to consider how they can be made of more service both to the industry of agriculture and to the nation as a whole. The fact that the compulsory powers for the control of farming, which were the subject of acute political controversy, have been repealed should make it more rather than less possible for the Committees to do useful work unaffected by party spirit or political bias. The position is that instead of the Committees being the policemen of agriculture, they must rely on the arts of persuasion, education and example.

By these means it appears to the Minister that there is much useful work to be done. The varying conditions in different parts of the country require that the methods to be adopted should also vary, but the Minister hopes that the members of each Committee will regard themselves as collectively and individually responsible for agricultural development in their area, and will consider seriously and systematically what action they can take to promote it.

It is clear that no drastic measures which would arouse acute political controversy are practicable, and accordingly agriculture must aim at the improvement both of men and of methods and the avoidance of waste if success is to be attained. For these purposes education in the broadest sense of the word will be the most effective agent. In counties where agricultural education is controlled by the Agricultural Committee, the task of making the best use of the existing educational facilities and of developing them where possible is one to which the Committees should bend their best efforts. A sound foundation of agricultural education has been established, but much more use might be made of it by all classes of agriculturists. The expenditure on it is therefore much less fruitful than it ought to be. How many farmers avail themselves sufficiently of the practical advice and assistance that they can obtain from the County Agricultural Organiser, from the Horticultural, Dairy or Poultry Officers, or from the Agricultural Colleges or the Advisory Officers attached to them? Again, how small in comparison with the total are the numbers of those who have even once paid a visit to one of the great Research Institutions, and how few there are comparatively who are taking full educational advantage of the valuable schemes for the improvement of livestock. The Ministry endeavours to make known these and other educational

facilities by leaflets and by its *Journal*; but members of Agricultural Committees responsible for agricultural education might well consider whether they could not do more both collectively and individually to spread this knowledge. In particular, members of Agricultural Committees have a special responsibility for the statutory small holders and allotment holders who have been established under the Small Holdings and Allotment Acts. It is specially desirable in their case to see that all possible assistance is given to them by the Organisers and Instructors on the County Agricultural Staff, and it is suggested that the Small Holdings Sub-Committee should give special consideration to this question in consultation with the Committee responsible for agricultural education.

It would be of enormous assistance if every Agricultural Committee would do its utmost (as an official body where it controls agricultural education, as individuals where agricultural education is administered by another Committee) to bring home to every farmer in its county the opportunity and facilities provided through the County Staffs and Agricultural Colleges and the Research Institutions.

Another direction in which the Minister is of opinion that Agricultural Committees can render valuable service is by the promotion and encouragement of sound schemes for the improvement of the facilities for marketing agricultural produce, whether by co-operative organisation, by transport developments, or by other means. The Ministry proposes to appoint a small staff to investigate marketing problems on the lines recommended by the Linlithgow Committee, and it is hoped that their work will be of considerable assistance in determining the directions in which reforms may be accomplished and better organisation secured. It is of the first importance, however, to obtain the co-operation of farmers themselves in attacking these problems, and the Agricultural Committees can do much by ventilating the subject and arousing interest in it.

The Minister believes also that there would be great advantage in a systematic effort to popularise and standardise British agricultural produce. Experience shows that home produce is usually preferred by the industrial population who are prepared in many instances to pay higher prices for British than for imported produce if they can rely upon obtaining it in uniform grades and of first-rate quality. Much might be done in this direction if arrangements could be made for organised bodies of farmers or smallholders to undertake to supply the needs of

organised bodies of consumers, such as the Industrial Co-operative Societies.

The influence of the Committee should also have a considerable effect in raising the general standard of farming and creating a sound public opinion as to the responsibilities which the occupation of land entails. It cannot be denied that there is a growing tendency among certain sections of the industrial population to criticise adversely the manner in which some of the land of the country is being farmed, and the lack of business organisation in the industry. While such criticism is not infrequently ill-formed and made with insufficient recognition of the farmer's difficulties, it is a healthy sign that the towns should take an increasing interest in agricultural problems, and it makes it all the more important that all reasonable grounds for criticism should be removed in order that the danger of hasty or unwise action in the direction of control may be avoided. Committees might therefore undertake a survey of the agricultural conditions of their county, and make it their business to use wherever necessary the powers they possess to deal with injurious weeds under the Schedule to the Corn Production Acts (Repeal) Act, 1921, and also their power to grant on the application of a landlord a certificate under Section 12 of the Agricultural Holdings Act, 1923, in cases where tenants are not cultivating their holdings according to the rules of good husbandry.

On the other hand, it is undeniable that the best farmers in this country are unsurpassed in any part of the world, and it is desirable that publicity should be given to specially successful enterprises of the most progressive and up-to-date farmers in their area. It would be a useful piece of work if the Agricultural Committee—either by themselves or, where necessary, in co-operation with the Education Committee—could arrange with such farmers for periodical visits to their farm, not only by other farmers and smallholders, but also by representatives of urban industries.

Enough has been said to indicate in general terms some of the directions in which the Minister thinks that the Agricultural Committees can play a more active part in rural developments. The important thing in the Minister's view is that the Committees themselves should consider what methods are best adapted to their own localities, and should make suggestions as to the manner in which they can most profitably advance the cause of agricultural development.

The Minister has secured the provision of additional funds which should be sufficient to meet any additional expenses which may be incurred by Committees in the current financial year.

Note.—A circular letter in the above sense was addressed by the Ministry to Local Authorities in England and Wales on 5th June.

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MACHINERY ON THE FARM.

H. G. RICHARDSON, M.A., B.Sc.,

Ministry of Agriculture.

The Coming of the Machine.—At the beginning of the 19th century there was no machinery upon the ordinary farm. The farmer's implements, save in quite exceptional cases, were limited to the plough, harrow, roller, and the hand tools with which he reaped, stacked, thrashed, hedged, ditched and drained. There were innovators who were not content with the traditional equipment and methods of the farm; but new devices were rarely practical. The most marked progress had been in the design of the plough; it was found that the draught could be greatly reduced and great economies effected in horse and human labour, and slowly the modern plough gained general acceptance.

Even with horse and manual labour, however, there is scope for great mechanical development, and horse gears have in the past been used and occasionally still are used for such operations as thrashing, mole draining and raising water: the drill, the reaper, the binder, the swath turner, the hay loader all show what can be performed mechanically with no other power than the horse. But for all that the great advance came, as it did in the manufacturing industry, with the application of steam; even the development of horse-propelled machines is largely due to the stimulus originally given to mechanical invention by steam.

Power.—For heavy work animal power is unsatisfactory. In literature of a century ago may be seen proposals for such implements as draining ploughs which demanded a team of twelve horses; and although mole draining can actually be done and still is performed by horse tackle geared very low, the work is prodigiously slow. Two developments took place side by side: (1) the application to thrashing machines and barn machinery generally of the portable engine (largely superseded later for

thrashing by the traction engine), and (2) the application of cable engines to ploughing, draining and cultivating. With steam engines in these forms, power made a definite appearance on the farm.

The internal combustion engine came later in the 19th century. In the 'nineties the oil engine began to make its way on the farm. At first its uses were limited and it was only employed for such operations as grinding, chaffing, pulping and pumping. Attempts however, were being made to use engines as tractors for cultivation. The Derby Digger was an ambitious attempt to supersede ploughing; but other inventions were based upon an endeavour to find a substitute for the horse. Both steam and internal combustion engines were used for the purpose; such pioneers as the Mann steam tractor and the Ivel and the Saunderson tractors are well known to middle-aged farmers. It was not, however, until the late war period that tractors came into any-like general use in this country. By that time they employed, with extremely few exceptions, an internal combustion engine, and they had reached a comparatively high level of efficiency, although since the designers were influenced by the developments in motor car construction a good deal had still to be learnt before tractors generally became well adapted to field conditions. Implements also required a good deal of modification before they became fitted to the different conditions of tractor draught. Many of the implements at first coupled up with the tractor were found to work unsatisfactorily, due not a little to the employment of implements designed for horse haulage. To many it was something of a discovery that a different motive power demanded different tools, and the coming of the tractor has done more than anything else to stimulate inquiry into the design of agricultural implements.

The popularity of the tractor during the war was due in part to the high price of horses and of their keep. When animals and foodstuffs both fell in price the popularity of the tractor waned. Moreover, the tractor was found by the average farmer to be far less satisfactory than it appeared to be on the demonstration field; it seemed to be subject to frequent breakdowns and to require extensive and expensive repairs. Often these faults may have been in measure due to the tractor, for manufacturers had, as we have suggested, a great deal to learn in the way of design; but much of the trouble was due to the farmer or the farmer's man, who neither understood the tractor nor took any reasonable steps to keep it in running order. Not infrequently

inefficiencies due to faults in the design of tractor implements were put down to the tractor. The horse too was familiar; skilled men could be had for horses, but they had to be sought for the tractor. The tractor to-day is under a cloud.

The Economies of Power.—What then is the use of power in farming? The answer is supplied by the engines which drive the barn machinery and which every one regards with approval. Power enables operations to be performed which, if not otherwise absolutely impossible, could only be performed at the cost of excessive fatigue of animals or men; and it enables these operations to be performed much quicker. These are gains even if the unit cost is the same; they may be gains even if the unit cost is higher. A telegram is more expensive than the post, but it is cheap at the price.

Many farmers have retained a light tractor for harvesting after discarding it for all other operations. In unit cost there is no appreciable gain over the horse in using a tractor to draw a single binder, but the saving of time is undeniable. The tractor moves at a greater speed and works continuously throughout the day up to any hour in the evening, while eight or nine hours or ten at the most of broken time is as much as a horse can reasonably be expected to give. Consequently with the tractor there is a much greater possibility of taking advantage of fine weather. There is a similar advantage in the use of the tractor for ploughing. No farmer needs to be taught that a gain in time makes all the difference in the world in the final return to the farm. That is one aspect of the machine. There is another aspect. Although there may have been no very precise knowledge of the cost and value of such operations as mole-draining and sub-soiling, it has for very long been recognised that they might add very considerably to the fertility of a farm. But except where cable sets were occasionally employed, few farmers of the present generation have mole-drained or sub-soiled, probably because of the strain on the teams and the amount of time consumed. The tractor makes it possible for any farmer who so desires to sub-soil or to mole-drain. The tractor does not work upon so large a scale as the cable-engine, but, so far as can be judged, the work is equally effective, and a pound's worth of tractor work may safely be regarded as equal value to a pound's worth of cable work—indeed it is argued that the small, comparatively shallow, moles that the tractor makes are more effective for the farmer's

purpose, at least in some soils. Be that as it may—for the settlement of such points may be left to scientific investigation by the Oxford Institute of Agricultural Engineering—both tractor and cable engine convey the lesson that power will perform at reasonable cost what horse labour, for all practical purposes, cannot do.

Power is the big man's friend. Even the smallest tractor cannot be used to its utmost value on the small farm; the economies of power are seen on the large scale. The small man must too often work with what are practically the implements of his forefathers; even a new drill is an expensive luxury for a small farmer to own. He needs to be content with a secondhand machine discarded by his bigger neighbour. An expenditure of twenty pounds or so on a swath turner which can be employed only during three or four days in the year is practically prohibitive and economically unjustifiable to the small man who at best wants it for a few hours. The small man may make a living, he may even thrive; left to himself, however, he can get little benefit from machines or from power. But that is not the end of the story: a group of small men may constitute one big man, and may use all the resources of power and mechanism very nearly as well as the big man.

The future of farming lies in the employment of power and machinery, and large scale production inevitably has very great advantages. The tractor enables any farmer with a moderate-sized farm to get nearly all the advantages that power can confer. He obtains the advantages of time saving and the ability to perform heavy operations; except on the stiffest land he is independent of outside contractors, for there are few soils that the tractor will not plough; there is no corn that it will not thrash with a modern thrashing machine. We have said so much of the tractor because it is typical of modern developments in the application of power to the farm. We shall find space to say a little of other forms; but we may as well take the tractor as illustrating other aspects of the problem of machinery on the farm.

Choice and Care.—Half the trouble with machinery arises from buying and using the wrong sort; the other half arises from misuse. When tractors became popular it was not at all unusual for the farmer to buy and couple up unsuitable implements. The selection of implements in the past has usually been largely based upon custom, which, on the whole and with an extremely limited range of types, worked well in eliminating

the obviously unsuitable. The reverse of the picture was seen in the reluctance of many farmers and farm workers to take up new implements and in their inability to form an independent judgment on the merits of a new machine. The ordinary farmer confronted with a new machine was unable to be certain whether it would perform a certain operation under known conditions with a minimum expenditure of power; and if the machine failed he could not, as a rule, say why or where it failed. There has been a general inability to appreciate why a machine is designed in a certain way or the reasons underlying its several parts. It has not been exceptional to find a ploughman discarding removable coulters and getting the smith to weld them in the old fashion; or a farmer stating that a tractor would not sub-soil, when the trouble was the employment of a cumbrous ill-designed plough of enormous draught and a sub-soiling tine of gargantuan dimensions.

But the relation of means to the end has been little appreciated in all that concerns farm machinery. An implement that is not selected for the precise work it has to perform can only be right by the merest chance; unfortunately exact knowledge is not easy to attain, and can only be gained by close and continued observation or by scientific investigation. An excellent example of the kind of knowledge that is required is afforded by the investigations into potato-diggers at Leeds, which showed not only the relative advantages of different makes, but what is even more important the advantages of different types embodying different principles. Knowledge of the same kind is required with regard to such implements as the drill, for there is more than mere personal preference in a choice between disc, coulter or duckfoot, between force-feed and cup-feed. Even more important is exact knowledge of the use of the many types of plough; the problem is complicated because there is at present no certain criterion of good ploughing, the relation of ploughing to tilth and to crop being affected by a great many factors, knowledge of which is at present far from complete.

The farmer cannot wait for the accumulation of knowledge. He must make up his mind how he wants a job done, and he must endeavour to secure that the job will be performed as speedily as possible and with the least expenditure of power—human, horse or mechanical. If he judges machinery by these principles and exercises his judgment, while keeping his eyes open for the results of scientific investigations into agricultural machinery, he will not go far wrong in his choice.

Just as important as choice is the care of the machine. Every implement on the farm should be put away after use in such a state that it will be again ready for use whenever it is required. Even such implements as the plough and the cultivator may have their natural life shortened by a half by leaving them in the open. Weather will deteriorate anything made of iron or wood; nor is deterioration the only loss. There are the losses of time and efficiency before the implement is working again properly. A plough with a rusty breast will scour clean, but while it is scouring, power is being lost and the job is being indifferently performed; no great trouble is involved in greasing a plough breast before putting it away. The more complicated the machine the greater the necessity for care; the results of neglecting a plough or a cultivator are not painfully obvious, but neglect of a mower, a binder or a tractor forces itself upon the attention. Too often, certainly in the case of the tractor, the matter settles itself by a general condemnation of inventor, designer and manufacturer, and a hasty scramble to put things right: under such treatment no machine can give reasonable satisfaction. Care when the machine is put away implies care when the machine is running. The simpler implements take care of themselves with a minimum of attention; but the more complicated machines require to be exactly adjusted to their task. Neglected lubrication, a dull set of knives, a wrong adjustment or alignment of the cutter bar will greatly reduce the efficiency of a mowing machine. Errors in lubrication and fuel are the most fruitful sources of trouble with the tractor. And the tractor provides a frequent example of another kind of want of care—demanding of a machine a task beyond its capacity.

The Large Machine.—In conclusion a word may be said of the larger types of machine which no ordinary farmer would own. The largest machines in ordinary use are steam cable sets, for the most part in the hands of contractors and large land-owners. On a smaller scale are internal combustion cable sets, and it may be that when in due course electricity is available on every farm cable work will be the normal system. Until that day arrives, the use of the cable system must necessarily be limited, although for a large area of land the great capacity and speed of a cable set as well as the economy in tractive effort—for unlike the tractor the cable engine does not have to propel itself and work at the same time—give it very definite advantages. No comparative data are available, but this seems

obviously to be another instance of the advantage possessed by large scale production in the utilisation of power.

Other machines with which this country has been made more or less familiar are those for cutting trenches for tile draining. In speed and efficiency they are superior to any manual labour, and none but the poorest paid labour could possibly compete in terms of money. The larger machines, such as the " Buckeye," are not farmer's tools: even a large landowner could hardly hope to keep one fully employed. But if field drainage is to be given proper attention in the future, machines such as these in the hands of contractors seem to be the most promising means at hand. Other machines, on the lines of the well-known " Revolt," perform very creditable work in suitable conditions, and this type, which can be propelled by any ordinary tractor, is likely to be so improved in design as to make it more generally successful. On very large areas of land a machine of this type will always be useful, and the price at which it can be manufactured does not make it impossible for the larger farmer to own one. But for the stiffest land and for deep cutting and exact work a heavier and more complicated machine is required; and the machine of the " Buckeye " type is in a class by itself.

Very little agricultural machinery is being bought to-day, and until there is more money in agriculture very little will be bought: but the ultimate success of agriculture will depend more upon the economies of power and the machine than upon any other external aid. Just as in manufacturing industry, the use of power will tend to larger scale production, to bigger economic units; but after all, that is what is really meant by co-operation, the development of which will itself develop the use of power and machinery upon the farm.

* * * * *

ROTATION OF CROPS.

I.

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Most of the arable land of Great Britain is cultivated according to some regular and well recognised succession or " rotation " of crops, which experience has shown to be well suited to the local natural conditions and circumstances. In travelling through agricultural districts it is interesting to note how varied are the rotations followed, and to trace the way in

which the variations enable the farmer to take advantage of some special local circumstance or to overcome particular natural difficulties.

While there can be no doubt as to the necessity of having on most farms a fairly definite rotation, it may be pointed out that the existence of a settled plan of cropping on, say, a four, five or six course, makes it difficult for the farmer to adapt his system of farming quickly to altered conditions, and is largely responsible for the traditional view as to the conservative habits of the agriculturist. None the less, it will be found that systems and rotations are continually changing to meet altered circumstances, but such changes are necessarily slow and not always apparent to the casual observer. A farmer is not in the position of a general merchant who can easily concentrate on a new line of goods and drop less profitable ones. He resembles more a self-contained industrial combination which, while searching for and testing new processes and markets, has to keep its existing plant fully employed, and to utilise all its varied raw material.

Object of Rotations.—The following are the chief reasons for growing crops in a regular and definite sequence :—

(1) It enables the land to be kept clean and in constant cropping with the minimum expense.

(2) It provides food in suitable proportions for the stock of the farm, and enables the productivity of the soil to be maintained without excessive expenditure on manures or feeding stuffs.

(3) A well-arranged rotation enables the work of the farm to be well distributed over the year, and provides steady employment for a whole-time staff. By alternating root crops with corn, a considerable saving of labour is effected, as the thorough cultivation given to the former enables the soil to be prepared easily and cheaply for the latter.

(4) While some crops, *e.g.*, wheat and mangolds, can, if necessary, be grown year after year on the same land, others, such as swedes, clover, beans, and to a less extent oats and potatoes, if so grown, are likely to be seriously affected by special diseases and pests. Rotations are therefore arranged so that such crops do not occupy the same ground more frequently than is found by experience to be safe.

(5) Corn crops, following other crops, make use of accumulated fertility and tend to leave the land more weedy than others, while root crops and potatoes are so cultivated and

manured that the fertility of the soil is increased and weeds are reduced. In other cases, as, for instance, with clover, beans, peas, etc., the crops actually enrich the soil by the nitrogen taken from the air and left behind in their roots. Therefore, the general frame-work of most modern rotations is an alternation of corn crops with what may be called restorative crops, and as a rule corn crops occupy about half the cultivated area, the remaining half being divided between root crops and clover, or beans and peas. Old leases or agreements frequently contained a stipulation as to the proportion of roots and "seeds," thus preventing an excessive area of what were regarded as exhausting crops. Legislation now exists to give the tenant fairly full freedom of cropping, subject to certain safeguards of the owner's interests, and the proportions given above are frequently varied considerably, but the general arrangement indicated is usually a sound one.

(6) Sheep play a very important part in British farming, and in most districts some of the crops included in the rotation are consumed by sheep on the field in which they are grown. For reasons, which need not be entered into here, sheep, more than any other kind of stock, benefit by change of ground; furthermore, on certain kinds of soils the folding of sheep restores the fertility in a way which hardly any other kind of treatment can do. By having suitable rotations the various fields of the farm are folded in turn, and thus the sheep continually get fresh ground, and at the same time the productivity of all the arable fields on the farm is maintained.

(7) In the absence of a definite rotation it would almost inevitably happen that the fields remote from the farm buildings would be starved, while those conveniently situated near the homestead would receive an undue share of manure and of crops cultivated on restorative lines. It must be admitted that even with a rotation there is frequently a tendency in this direction, but matters would be much worse did not recognised rotations exist.

(8) In a proper rotation one can take advantage of the fact that crops differ in their manurial requirements. The most important manure is farm-yard manure, which supplies all the three important ingredients, nitrogen, phosphates and potash. The crop to which it has been applied may have drawn more on one material than the others, and a suitably arranged rotation enables full use to be made of all the plant food supplied.

Chief Conditions which Determine Rotations and Systems of Farming.—(a) *Climate*, including rainfall, temperature—average and extremes—and exposure.

Climate is in many ways the most important condition affecting rotations, and in particular *rainfall* is very often found to be the vital factor. Not only does it determine the character of the arable crops grown, but it affects the proportion of arable and grassland. Where the rainfall is high, as in most western districts, grass predominates, and arable crops are restricted mainly to oats and roots. In the drier eastern areas the proportion of arable land is much greater. Wheat and barley replace oats on many farms, while potatoes and a variety of other special crops are cultivated on a large scale in suitable situations. The following table, based on the 1914 statistics, compares five typical eastern counties with five western counties.

PERCENTAGES OF TOTAL AREA OF ARABLE AND GRASSLAND.

			Arable land (excluding Clover and Rotation Grasses)	Oats.	Other Corn Crops.	Potatoes.
<i>Eastern</i>						
Essex	...	...	55.9	7.5	31.8	1.74
Norfolk	...	...	58.8	7.1	22.4	1.61
Yorks E.R.	...	...	53.6	12.6	23.8	1.71
Berwick	...	...	42.8	15.7	11.5	1.57
Forfar	...	...	55.3	19.4	15.1	7.39
<i>Western</i>						
Devon	...	...	26.3	9.9	7.0	0.85
Pembroke	...	...	19.2	8.8	6.2	0.70
Anglesey	...	...	18.1	11.6	1.2	1.28
Cumberland	...	...	19.8	12.2	0.4	1.40
Wigtown	...	...	29.8	19.2	0.4	0.84

In the first group the proportion of the land ploughed in any year is about 50 per cent., while in the western group the average is not much over 20 per cent. It cannot be said that soils and other conditions are exactly similar in the two groups, but there can be no doubt that the great differences between the two sets of figures are mainly the result of differences of rainfall. As illustrating the importance of rainfall in determining agricultural practice, Sir John Russell, in a recent article,* described two soils, one from Anglesey with a rainfall of 35 inches, the other from Suffolk with a rainfall of 23 inches. The former is rated as fairly good agricultural soil used for potatoes and carrots; the latter is waste land of absolutely no

* See this *Journal*, May, 1924, p. 120. "Soil Improvement."

value, although, from the point of view of texture it is slightly better than the former, which contains as much as 93 per cent. of coarse sand. On the other hand, a heavy loam soil might be regarded in a dry district as useful arable land but as unfit for cultivation in a wet area.

Under lowland conditions differences of *temperature* are by no means so important as differences of rainfall, and the effect of temperature on agricultural practice is not nearly so great, except in the case of upland districts. At the same time, the effects of frost, summer heat, and amount of sunshine, are of considerable importance. For instance, mangolds are very rarely grown in Scotland on account of their susceptibility to damage by frost. Similarly, winter oats are not extensively grown north of the Humber. Early potatoes are cultivated in districts where there is known to be little or no danger of damage by spring frosts—*e.g.*, Cornwall, the Ayrshire coast, and other smaller coastal districts. Milling wheat and malting barley require more sunshine, and tolerate greater heat than spring oats, which prefer a cooler as well as a moister climate. The growing of special seed crops on a large scale can only be successfully practised where hot, dry summers enable them to be ripened and harvested in good condition. It is beyond the province of this article to discuss fruit and vegetable crops, but the distribution of these affords an interesting study in the effect of climate as well as soil on practice.

Reference may perhaps be made to the effect of *exposure* and liability to damage by gales. This is of vital importance in fruit culture, and even with ordinary farm crops a gale about harvest time may easily cause very serious damage to corn and potatoes, and this helps to restrict the area of such crops in bleak situations. It need hardly be said that the effects of climate are not confined to the direct effect on the growth of the crops themselves. The risk of damage by unfavourable conditions—particularly rain or frost—before the crop can be safely harvested is an important consideration, and the earliness of harvesting and the customary time of sowing, both dependent on climate, directly affect the rotation. Where corn harvest is early and seed time for roots late, as in the south of England, there is an opportunity of cultivating catch crops, as is done in the Wiltshire and other rotations practised in the south of England.

(b) *Soil*, including general character, depth, fertility, slope, drainage, etc.

Even where the climate is suited to arable cultivation, soils, such as heavy clays and steep stony slopes, which can only be cultivated at great expense, tend to be laid down to grass, or at any rate to be cropped on a rotation including a temporary grass ley. Similarly, low-lying fields, or badly drained soils, are left in grass. Leaving out of account, however, such extreme cases, the various classes of soil are naturally suited to different crops. Such descriptions as "wheat and bean land," "good sheep and barley soil," convey more meaning to the farmer than a lengthy detailed description of the soil itself would do. Generally speaking, wheat, beans and bare fallow, with some mangolds, cabbages and red clover are characteristic of the clay soils. Potatoes, carrots and rye are the best crops for practically pure sands. Barley, swedes and turnips do best on fairly dry soils of medium texture. Oats flourish in soils containing a good deal of organic matter, and are the best of the corn crops for peat. Vetches, peas and leguminous crops, with the exception of beans, are cultivated most extensively on chalky soils.

(c) Accessibility and Facilities for Marketing Produce.

This perhaps needs little comment, as it will be generally realised that a farmer who lives several miles from a station will naturally wish his produce to "walk to market." On the whole, in this country, accessibility is not so important a factor in determining the crops grown as suitability of soil and climate. If the latter are particularly fitted to a certain crop for which there is somewhere a good demand, transport difficulties will somehow be overcome. For instance, the Fen district is remote from big centres of population, but none the less it is one of the chief areas from which the potato supply of large towns throughout the south and midlands of England is drawn. Similarly a large raspberry growing industry has been developed in rather remote districts of Perthshire, while the London milk supply is drawn from a very wide area, including the south, west and north-west of England.

(d) Labour.—The securing of sufficient or properly skilled labour often presents great difficulties when it is desired to adopt new systems, or to raise crops requiring special skill in handling, but it is rarely found that this is a permanent obstacle, except where it is desired to introduce in a thinly populated remote district some crop or method which demands a large supply of experienced labour for a short period only.

(e) Fluctuations in market prices affect the proportion of crops grown from year to year, though the majority of farmers

wisely make such changes very cautiously, as they have to plan for some years ahead, and it by no means follows that a specially high price for one kind of farm produce will be obtainable for two or more years in succession. Notorious examples of this uncertainty are peas and potatoes.

(f) *Other circumstances* of a more specialised character often have some effect. For instance, the existence of a hill grazing may make it necessary to devote the lowland cultivated area almost exclusively to the growth of winter food for the hill stock. The size of fields, nature of fences, water supply, etc., determine to a great extent whether temporary leys for grazing can be adopted. The presence of game, birds, rabbits, etc., may make it desirable to reduce the area of corn. On the other hand, the farmer himself may have a special liking for certain crops or systems of farming, which do not appeal to his neighbours.

In the long run, however, climate, soil, markets, and prices are the main factors which determine the rotation followed, though other influences may result in temporary deviations from the general rule. At the same time, changing conditions, particularly those of prices and markets, make it necessary to introduce changes in cropping, and there is need for more rapid adjustment than commonly exists. Such need is, for instance, often clearly seen where local farmers in a remote district have failed to realise the possibilities opened up by the inrush of a large population as the result of the establishment of large works, or the development of a seaside summer resort. A farmer coming to a new district usually sees ways in which greater efficiency and better results can be obtained, though, if he is wise, he will wait until he has gained a fairly thorough knowledge of local conditions before attempting to introduce crops and methods totally new to the district. The value of fresh blood and new methods can be seen in many parts of the country, but it will generally be found that the most successful innovators have proceeded at first with a great deal of caution, and have made it their business to understand thoroughly the old methods before departing far from them.

(To be concluded.)

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THE PHYTOPATHOLOGICAL SERVICE OF ENGLAND AND WALES.

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IN most of the civilised countries of the world there now exist more or less completely organised services, under Government auspices, for dealing with the diseases and pests of cultivated plants and crops. Such phytopathological services vary to some extent in character and mode of operation in the different countries, and a summarised account of those then existing was published by the International Institute of Agriculture in Rome ten years ago.* Since that time, so far as England and Wales are concerned, there have been considerable developments, and the account given in that publication no longer reflects accurately the condition of affairs.

The present time, when visitors from all parts of the Empire, many of whom have interests in agriculture and horticulture, are coming to this country for the purpose of seeing the British Empire Exhibition, seems to be opportune for presenting a fresh survey of the present state of our official phytopathological activities, and this article is intended to present a résumé of the various phases of work carried out directly or indirectly by the Government with the object of controlling the damage caused by plant pests and diseases in England and Wales.

These activities cover many fields of work. They deal with the primary function of identifying organisms which cause damage to crops, with fundamental research on entomological and mycological problems, with investigations as to the means of control which can be adopted in practice, and also with the formulation and administration of Acts and Orders designed to prevent the introduction of pests and diseases from abroad and to restrict the spread of those which are indigenous or established here.

Origin and Development of the Service.—Whilst there is no need to trace the development of the service in any considerable detail, nevertheless, the present state of affairs will be more easily understood if some account of its origin be given. About the year 1877 the country became seriously alarmed at the possibility of the introduction of the Colorado Potato Beetle into

* "Le Service de Protection des Plantes dans les divers Pays." IIe Edition. Rome. Imprimerie de l'Institut International d'Agriculture, 1914.

Britain—an alarm which was intensified by the knowledge of the disastrous results which had occurred on the European continent consequent on the appearance of the American Vine Phylloxera a good many years earlier. As a result, the Privy Council was empowered by Parliament to issue such Orders as were necessary both to keep out the Colorado Beetle and to deal effectively with incipient colonies of this pest should any make their appearance. No special staff of inspectors or other officers was created for the purposes of the Act,* but its administration was left to the ordinary civil authorities of the country. In 1889 the powers of the Privy Council in regard to this Act were transferred to the Board of Agriculture, but this appears to have brought about little or no change from the standpoint of phytopathology.

The next landmark is the Act of 1907† which enlarged the Board's powers and enabled it to deal not solely with the Colorado Beetle but also with all insects, fungi and other pests which may attack any crops, trees and bushes. This Act, like its predecessor, also appears to have had its origin in a wave of alarm, caused on this occasion partly by the discovery of the presence in Britain of the very serious American Gooseberry Mildew, from which the country had hitherto been absolutely free, and partly by fear of the possible introduction of the San José Scale insect which was doing so much damage to fruit trees in the United States.

Research and Advisory Work.—At this point it is necessary to digress a little from legal and administrative matters and to go back a year or two in order to trace the beginnings of a definite system of research and advisory (extension) work in connection with plant pests and diseases. Apart from Sir Charles Whitehead, who devoted much time to insect pests when Chief Scientific Adviser to the Agricultural Department of the Privy Council (and later to the Board of Agriculture), there was no whole-time entomologist or mycologist on the staff of the Privy Council or the Board. Noteworthy during the period, however, are the names of Mr. F. V. Theobald, Dr. R. Stewart MacDougall (entomologists), and the late Mr. G. Massee, of Kew (mycologist), who acted either directly or through their Departments as advisers to the Board. Special mention must also be made of Miss Ormerod, who, as Consulting Entomologist to the Royal

* "An Act for preventing the introduction and spreading of Insects destructive to Crops." 40 and 41 Vict., Ch. 68. 14th August, 1877.

† "An Act to extend the Destructive Insects Act, 1877, to all Pests destructive to Crops, Trees and Bushes." 7 Edw. VII, Ch. 4. 4th July, 1907.

Agricultural Society, followed John Curtis as a pioneer in economic entomology in England. These scientific workers all did magnificent work on behalf of agriculture and horticulture, but they cannot be claimed as having been members of any official phytopathological service.

In 1909 and 1910 considerable progress was made as a result of the passing of the Development and Road Improvement Funds Act, 1909, which *inter alia*, provided resources for a definite scheme of research, investigation and advisory work in agricultural and horticultural plant pathology. Without exceeding the limits of the present article, it would be impossible to give any comprehensive account of the developments which have been possible through the agency of this Act, but it may be stated that, as a matter of policy, it was decided that the funds rendered available should be expended in the main (a) on subsidising existing scientific institutions in order to enable them to undertake research in one or more of the component subjects of agricultural science; and (b) on the subsidising of the same or other similar institutions in order to develop local investigation and advisory work within definite areas or "provinces." Under this scheme scientific workers were, therefore, attached to the staffs of research or teaching institutions (universities and agricultural colleges), and they became ordinary members of such staffs and not Government officials.

So far as fundamental research is concerned, two institutes were at first created to deal with plant pests and diseases, viz., one of Agricultural Entomology at Manchester University and one of Plant Pathology at the Royal Botanic Gardens, Kew.* A third institute, dealing with Agricultural Helminthology, was also established at Birmingham University. As regards local investigation and advisory work, the colleges and institutions concerned were left practically free to appoint specialists in those branches of agricultural science in which it was considered the existing staffs required strengthening. From the outset, however, there was a tendency to appoint entomologists and mycologists, partly because these subjects were not already well represented, but perhaps chiefly because applications received from farmers and fruit growers for advice were so frequently concerned with phytopathological questions.

In consequence of the passing of the Destructive Insects and Pests Act, 1907, and while the organisation under the Development Fund was taking shape (1909-1914), a significant move had

* These two institutions have now been combined and transferred to the Rothamsted Experimental Station.

been made by the Board of Agriculture in the creation of a staff of inspectors specially set apart for the administration of the Acts dealing with plant pests, and also in the appointment of an entomologist as a permanent member of the headquarters staff of the Board. The local authorities also appointed inspectors to administer the Orders issued by the Board under the Acts, but in 1914 the entire administration of the Orders was taken over by the Board.

Immediately before the outbreak of the War in 1914, therefore, there were two organisations engaged, or destined to be engaged, in the fight against plant pests and diseases—a small body of Government officials under the Board of Agriculture, whose main duties were to administer the Destructive Insects and Pests Acts, and another body of scientific workers paid from Government funds, but not Government officials, who were appointed to conduct research, investigation and advisory work throughout the country. The existing phytopathological service, which may be taken as including both organisations, thus had a dual origin, and this has resulted in its separate parts remaining, from the administrative point of view, distinct.

At this point, however, the historical aspect of affairs may be left, since the nucleus of the present service has now been traced and subsequent developments have consisted essentially in natural growth along already settled lines.

Subsequent Development and Present Position.—The four years of the War, succeeded by the difficult period of post-war reconstruction, naturally impeded the growth of the phytopathological service to some extent, but in spite of fluctuations and changes in personnel, the scheme worked out by 1914 has persisted and has governed all subsequent development. The Service to-day, therefore, still consists of two main sections* :—

A.—The official section attached to and controlled directly by the Ministry of Agriculture (previously the Board of Agriculture).

B.—The non-official section distributed through the various Universities, Agricultural Colleges and Research Institutes of the country, financial provision for which comes from Government funds, but which is free from the detailed instructions of the Ministry, and subject only to a certain amount of supervision to ensure efficiency.

* The pests and diseases of forest trees for timber production are dealt with by the Forestry Commission, an organisation not described in the present article.

Each of these sections is sub-divided into certain definite units, and before attempting to explain how the whole field of work is thus covered, it may be well to indicate the composition of these units.

(a) *Official Section*.—This is divided into three units:—

(1) The Pathological Laboratory at Harpenden, which has a small entomological and mycological staff;

(2) An administrative unit, forming an integral part of the Horticulture Division of the Ministry in London;

(3) The Ministry's Inspectorate, about 30 members of which have special qualifications in regard to plant pests and diseases, although these officers are not exclusively employed on such matters.

(b) *The Non-Official Side*.—This consists of:—

(1) The Phytopathological Research Institute attached to the Rothamsted Experimental Station at Harpenden, and also scientific workers attached to such specialised research stations as the Long Ashton Fruit Station, Bristol; the Imperial College of Science, London; the Fruit Station at East Malling; the Lea Valley Station, Cheshunt (Glasshouse crops); and the Department of Helminthology of the London School of Tropical Medicine;

(2) The corps of advisers, consisting of an entomologist and mycologist in each agricultural province, fourteen in number.

The Government grants in aid of the work detailed under (b) (1) and (2) above are administered by the Research Branch of the Ministry of Agriculture.

At the end of this paper further details will be found as to the present personnel of the service, the areas covered by the various advisers, etc., but in order to understand the general working of the system, the above information will probably prove sufficient. In dealing with this aspect of the subject, however, some indication of the field that has to be covered must be given. In the practical control of any plant pest or disease the following stages have to be dealt with by one working unit or other, viz., diagnosis, research on fundamentals, investigation and trial of probable practical measures of control, and the rendering of the last-named available to the industry. In addition there must be some general intelligence system to record both the geographical distribution of pests and diseases and also their relative importance. Finally, legislation must be administered in order to check the introduction of pests and diseases, and, under certain conditions, to curtail the spread of such as are already present in the country.

This field of work is divided among the different parts of the service approximately as follows :—

The advisers diagnose troubles on behalf of the farmers and growers within their respective provinces. They carry out experiments on the practical control of pests of local importance and render the results of their work available to the industry, being assisted in this by members of the county educational staff, such as the county agricultural organisers and the horticultural superintendents*—who might, indeed, quite properly be regarded as having a definite place in the Phytopathological Service.

Research into fundamentals—*e.g.*, the physiological action of insecticides, the nature of immunity and resistance to disease, etc., etc., is carried out by the scientific workers stationed at the Research Institutes at Rothamsted, East Malling, Long Ashton, Lea Valley, the Imperial College of Science and elsewhere.

The Ministry's Pathological Laboratory at Harpenden has as its main function the provision of a scientific basis for the Orders issued under the Destructive Insects and Pests Acts and for all other special work required in connection with legislation of this type. It is also in charge of the intelligence system, that is the collection and distribution of information in regard to the spread and depredations of pests and diseases. Apart from this, however, this laboratory is at present very largely the "maid of all work" of the service, sharing to some extent both in investigation and advisory work, the former usually in co-operation with workers in other branches and the latter by such means as the preparation of leaflets and exhibits at shows. Finally, it has obviously to act as the co-ordinating centre for the whole service.

The practical work of administering existing legislation with regard to pests and disease, is carried out in the field by the inspectorate, and at headquarters by the Horticulture Division of the Ministry. These two groups also carry out, in co-operation with the laboratory at Harpenden, the very extensive work required in the necessary inspection and issue of certificates of health for consignments of plants going abroad. In the same way the control of plants imported into the country is provided for.

Each part of the service has its own sphere of operations in which it carries out its own independent routine work, but at

* These officers are employed and controlled by the various County Councils, the cost being borne in part by the county and in part by the Ministry of Agriculture.

the same time co-operation is continuous between the various branches of the service in dealing with both large and small problems. As important as, or second only in importance to such co-operation is similar co-operation between the officers representing the various sciences, since not only can an entomologist when in difficulty consult a mycologist, but also in practically every institute or station chemists, physicists and other specialists are available who can be, and indeed are, drawn into the net of the phytopathological service when required. It is thus possible to avoid one danger which may threaten a scientific service, viz., that of working in a watertight compartment.

The field of work is thus covered by a service which, though not under unified control and in consequence rather loose in its organisation, yet nevertheless works as a whole, and should prove capable of developing in future in any direction which circumstances may prove necessary. It must not be thought, however, that an official phytopathological service can provide all that the country requires—any more than the veterinary section of the Ministry and the various departments engaged in veterinary research can do all that is needed in connection with diseases of animals.

Plant diseases and pests cause losses comparable with those which result from animal pests and diseases, and similarly they require not only an official service but also a profession of workers like the veterinary profession. Even at present there are signs of the development of such a profession in the appointment of entomologists and mycologists by agricultural firms to investigate special problems. Further development along these lines may be expected in any branch of the industry in which the capital per acre involved is large and the profit in proportion, and also in cases where very large acreages are in the hands of single persons or firms. A considerable increase in the number of private practitioners, however, can scarcely be expected under present-day economic conditions, and it is probable that for many years to come the greater part of the work of pest and disease control will have to be carried on by the official service.

The role of a prophet is, admittedly, a dangerous one, but in concluding these notes it may not be injudicious to take a little risk and look to the possible future of the service. The development of the research institutes appears likely to proceed without much fundamental change either in their work or in their posi-

tion in the general scheme. The advisers, however, may in due time perhaps prove to have filled a stage in evolution rather than to have become a permanent institution. At present the range of knowledge required in an adviser is somewhat encyclopædic, and just as the old-time naturalist has been succeeded by the more specialised biologist of to-day, so it seems likely that the adviser may need to restrict his scope in certain directions, if he is to become and remain efficient in any. As the county councils' educational staffs develop they may prove able to take over more and more of the advisory side of the adviser's work, freeing the advisers themselves to an increasing degree for investigation—probably on certain defined ranges of crops. The adviser's field of work will perhaps not be determined so much by geographical or political boundaries as by the location of the particular type of crop on the diseases of which he has specialised, and such areas will be determined largely by the climatic and soil factors which operate in crop production. He will then be in a position not only to be expert in his own science, but also to be familiar with every aspect and detail of the cultivation of the particular crop or crops, the pests or diseases of which he investigates—a knowledge which is essential if really practical results are to be obtained.

With the purely official side of the service, it would not be proper for the writers of this article to deal—even in the rôle of prophets. It may, however, quite safely be anticipated that with the developments in communication between one part of the world and another, the problem of the introduction of foreign pests and diseases must become one of increasing importance; that Governments will more frequently be confronted with epidemics of diseases, comparable to the American Gooseberry Mildew in England and pests such as the Gipsy Moth in the U.S.A., than in the past, and that in consequence more work will be thrown upon the official section of the service. The task of workers in this section will be greatly lightened if the present tendency for co-operation between the official services of all countries should increase, since in this way it may be possible to deal with the problem not only by mere restrictions but also by developing nature's own methods of controlling pests and diseases before they have time to become epidemic.

Ministry of Agriculture and Fisheries.

Pathological Laboratory, Harpenden.	J. C. F. Fryer, Director (Entomologist).
	G. H. Pethybridge, Mycologist.
	R. Stenton, Assistant Entomologist.
	(Vacant) Assistant Mycologist.

Research Institutes at which Phytopathological work is undertaken.

1. Rothamsted Experimental Station, Harpenden.	A. D. Imms, J. Davidson, H. M. Morris, D. M. T. Morland, Entomologists. W. B. Brierley, J. Henderson Smith, Miss M. D. Glynne, Mycologists. Mrs. B. M. Roach, Algologist.
2. Imperial College of Science, South Kensington, London.	
3. University of Bristol Agricultural and Horticultural Research Station, Long Ashton, Bristol.	A. H. Lees, Entomologist. H. Britton-Jones, Mycologist.
4. East Malling Fruit Station.	H. Wormald, Mycologist.
5. Lee Valley Research Station.	W. Bewley, Mycologist (Director). C. R. Speyer, Entomologist.
London School of Tropical Medicine (Department of Helminthology).	(Vacant) Helminthologist.

List of Advisory Centres, Counties served and Advisers in Entomology and Mycology.

1. Armstrong College, Newcastle-on-Tyne.	Northumberland. Durham. Cumberland. Westmorland. R. A. Harper Gray, Entomologist.
2. Leeds University	Yorkshire.
T. H. Taylor, Entomologist.	W. A. Millard, Mycologist.
3. Midland College, Sutton Bonington, Loughborough, Leicester.	Lindsey, Lincs. Nottinghamshire. Derbyshire. Leicestershire. Rutland.
A. Roebuck, Entomologist.	H. H. Stirrup, Mycologist.

4. Cambridge University.	Holland and Kesteven, Lincs. Soke of Peterborough. Isle of Ely. Norfolk. Huntingdonshire. Bedfordshire. Cambridgeshire. Suffolk. Essex. Hertfordshire.
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F. R. Petherbridge, Plant Pathologist. W. A. R. Dillon-Weston, Assistant.

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| 5. S.E. Agricultural College,
Wye, Kent. | London.
Kent.
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Sussex. |
| F. V. Theobald, Entomologist. | E. S. Salmon, Mycologist. |
| 6. University College,
Reading. | Buckinghamshire.
Middlesex.
Berkshire.
Hampshire and Isle of Wight.
Dorset. |
| F. O. Mosley, Entomologist. | W. Buddin, Mycologist. |
| 7. Oxford University. | Northamptonshire.*
Oxfordshire. |
| N. Cunliffe, Entomologist. | R. Woodward, Mycologist. |
| 8. Seale Hayne College,
Newton Abbot. | Devonshire.
Cornwall. |
| W. E. H. Hodson, Entomologist. | A. Beaumont, Mycologist. |
| 9. Bristol University. | Herefordshire.
Worcestershire.
Gloucestershire.
Wiltshire.
Somerset. |
| L. N. Staniland, Entomologist. | R. Nattrass, Mycologist. |
| 10. Harper Adams College,
Newport, Salop. | Shropshire.
Staffordshire.
Warwickshire. |
| S. G. Jary, Entomologist. | N. Preston, Mycologist. |
| 11. Manchester University. | Lancashire.
Cheshire. |
| K. M. Smith, Entomologist. | E. Holmes Smith, Mycologist. |
| 12. University College of Wales,
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Radnor.
Brecknock.
Carmarthen.
Pembroke. |
| J. R. W. Jenkins, Entomologist. | D. W. Davies, Mycologist. |
| 13. University College of S. Wales and
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| H. W. Thompson, Entomologist. | J. Rees, Mycologist. |
| 14. University College of N. Wales,
Bangor. | Anglesey.
Carnarvon.
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Flint. |
| C. L. Walton, Entomologist. | T. Whitehead, Mycologist. |
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* The inclusion of Northamptonshire with the Oxford province is at present under consideration.

DAIRY FARM BUILDINGS, FITTINGS AND EQUIPMENT: THEIR RELATION TO CLEAN MILK PRODUCTION.

A. T. R. MATTICK, B.Sc.,

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THE success which has attended the clean milk competitions promoted by county and other authorities and supported by the Ministry of Agriculture, has resulted in an increasing appreciation amongst dairy farmers of the necessity for more hygienic methods in the production and handling of milk at the farm.

It has been shown conclusively that success in clean milk production rests largely upon the quality of the labour employed and the method practised. These, however, are not the only considerations, since it is certain that good buildings and well-chosen equipment render material assistance in the production of milk of the highest purity. Dark, ill-ventilated and insanitary cowsheds, for instance, are largely responsible for the spread of respiratory and udder diseases amongst housed cattle, which are deprived of the known benefits of fresh air and sunlight in destroying disease-producing and other organisms. The proper housing of the animals is of particular importance in those districts where climatic conditions compel stall feeding for many months of the year. Further, the amount of time and labour which must be expended in keeping the buildings and cattle clean is very largely reduced in well-designed and equipped byres.

Not the least point of importance is the psychological effect upon the workers who, serving under insanitary conditions, can hardly be expected to give of their best.

The great majority of dairy farmers and landlords will be concerned not with the erection of entirely new buildings, but with the improvement of those which exist. This article is, therefore, designed to apply chiefly to the latter.

The Cowshed: Ventilation.—It becomes abundantly evident in making inspections of existing cowsheds that ventilation has not in the past been a prime consideration in their construction. There is still a widespread prejudice in favour of a system, or lack of system, of ventilation, which allows the farmer to keep his cows "warm." Although it is certainly very undesirable that cows shall be exposed to draughts, the prevalent idea that

the milk yield of the animals is increased in proportion to increases in temperature has been shown to be a fallacy.

Elaborate systems of ventilation which depend for their efficiency upon constant adjustments of inlets and outlets are hardly likely to be successful. Efficient ventilation can be secured by the correct disposal of windows of the right type, which also serve to admit the light which is so necessary and so often absent. Those windows which are hinged at the bottom and open inwards are desirable, since they supply abundant fresh air and do not allow draughts to reach the cows. The old system of air bricks under the eaves is excellent. The raising of the ridge tiles at intervals provides an effective outlet for foul air in the absence of an extraction cowl.

Although the American system of housing stock and all the fodder under one roof does not recommend itself to English practice, many cowsheds have a loft above. In these cases it is often necessary to provide an air shaft with an extraction cowl to the apex of the roof.

Air Space.—It is not possible to dismiss the question of ventilation without a reference to air space. In spite of the fact that an efficient ventilating system can be made to remedy defects of air space, it is desirable that in making alterations to cowsheds every endeavour should be made to approach the minimum of 600 cubic feet per cow for large animals and 500 cubic feet for small ones. In considering air space the question of floor area is important, since height above 14 ft. is of little use. It is often wise when making internal alterations to sacrifice the use of an existing stall to considerations of air space.

Light.—Abundant light is essential and cannot be too freely provided. The position of windows should be so arranged that plenty of light falls on the hindquarters of the cows. The construction of the walls behind the cows sometimes restricts the amount of window space, and in these cases, when there is no loft above, existing tiles may be replaced by patches of Bridgewater glass tiles. Every effort should be made to provide at least three square feet of window space per cow.

Artificial Light.—The great majority of farms have not the advantage of a public lighting service, and the provision of good artificial light has been a matter of some difficulty. The old type of hurricane lamp is not adequate and requires constant attention. Incandescent petrol vapour lamps, which are economical and give ample light, are now specially made for use on farms.

Floors, Walls and Roofs.—In making interior alterations to the cowshed, the question of ease in cleaning must be kept in mind. Unnecessary angles and corners should be avoided and smooth, plain surfaces aimed at. The use of cement concrete has solved this difficulty on a large number of farms. It is relatively cheap, easily laid and durable. Practically any existing floor may be greatly improved by laying concrete to a depth of 6 to 7 in.

The practical farmer will probably question the wisdom of the use of concrete for cow stalls, on the ground that it is cold, and liable to cause udder chills. The objection is, however, not borne out in practice, since the amount of udder trouble on the large number of farms where concrete has been used and where clean milking is practised is undoubtedly less than under ordinary circumstances.

Walls.—Rough stone or brick walls can also be covered with a thin layer of cement, which greatly facilitates cleaning and prevents the accumulation of dust. Even wooden walls can be faced on the inside with cement to a height of about 4 ft. 6 in. The remainder of the walls as well as the roof can be kept in a sanitary condition by the frequent use of the lime wash spray. This latter is a cheap and effective way of disinfecting and keeping the sheds clean, and its use should be encouraged to the fullest extent.

Standings.—The dimensions and fittings of the standings are amongst the things which have the most important and direct bearing on the quality of the milk produced, and much unnecessary expenditure has resulted from failure to grasp the fact that raised standings are provided solely for the purpose of keeping the cows clean. In order that this may be done, the length of the standing from the edge of the manger to the edge of the gutter must not be more than 5 ft. or 5 ft. 6 in. for large cows like Shorthorns and Friesians and 4 ft. 6 in. or 5 ft. 3 in. for smaller cows like Jerseys, depending in each case on the types of neck fastening adopted.

That the comfort of the animals may not be sacrificed in a space apparently so short, it is essential that the manger shall be of the right construction. The height in front must not be greater than 12 in., and the width neither less than 2 ft. 6 in. nor more than 3 ft. The former width is necessary in order that the cow may rest her head on the manger, but it must obviously not be so great as to allow the cow to step forward and so foul the standing. In sheds where there is a double row

of cows head to head, or where there is a feeding passage, it is often necessary and important to provide a rail behind the mangers to keep the cows back. Existing mangers may usually be made to conform to this plan by dropping them to the floor level. Glazed half-pipes make very good mangers when set in concrete.

When making new mangers it is important to provide drainage for flushing them at intervals with water. Mangers may be made in concrete for each cow separately, or one long manger may be provided with spécial galvanised iron partitions, which can be swung out of the way when cleaning.

Height of Standings.—Much of the usefulness of raised standings is lost unless they are sufficiently high, and 10 in. should be regarded as a minimum from the bottom of the dung channel to the level of the standing. Any less depth of gutter than this is very liable to prove inadequate for keeping the cows free from their excreta. There should always be a fall of about 1 in. from the manger to the gutter. The smooth surface of the standing should be provided with shallow herringbone grooves which encourage drainage and give a foothold for the cows.

Width of Gutter.—The depth of the gutter in front must be 10 in. and 4 in. at the back, so that splashes may be arrested. To carry off the liquid part of the excreta the writer considers that a groove should be provided at the shallow side to which there should be a slight fall from the deeper side.

No gutter should be less than 18 in. wide and 24 in. is preferable. This width allows of the free use of brush and shovel in cleaning and encourages cows to step into it instead of attempting to step over, at the risk of slipping on the edge of the standing.

Total Length of the Stall.—The total length of each stall works out at from 7 ft. 6 in. to 8 ft., from the back of the manger to the edge of the gutter. Any attempt to lengthen the standings to more than 5 ft. 6 in., must result in failure to keep the cows clean. Width of manger, on which the cow's comfort so largely depends, should not be sacrificed to the width of the passages behind or in front of the cow.

Partitions.—Where space permits it is better that cows should stand separately rather than in pairs or in one unbroken row. In double stalls one animal is very liable to foul the bed of the other, and injuries to the udder are not infrequently caused by one cow treading on its neighbour. Wooden partitions are not desirable, and may be replaced economically by modern sanitary tubular fittings; these are durable and relatively inexpensive.

Methods of Tethering.—It is a matter of some difficulty so to tether the cows that they have sufficient freedom for comfort and yet are prevented from stepping forwards and fouling the standing, or backwards, and slipping into the gutter.

Perhaps the most effective method is the use of the galvanised iron stanchions lined with wood, which are supplied by English and Canadian firms. These give relative freedom of movement but do not allow the cows to step backwards or forwards. They have the additional advantage of being easily opened and closed, so that the time lost in securing the cows for milking is reduced to a minimum. Further, some types can be so adjusted that a stall of standard length can be made to accommodate cows of different lengths. This alignment device is very useful with a herd of cattle of different sizes.

Water Supply, Drainage and Disposal of Manure.—An abundant supply of water laid on to the cowsheds is both an advantage and a necessity, since a considerable quantity of water is needed for washing the sheds and the cows.

A tank for liquid manure would be a valuable addition to many dairy farms, and in order that this valuable fertiliser may not be unduly diluted with the water used for washing, an arrangement should be made to divert the highly diluted washings to the general drainage system. This may be effected by a two-way sluice which can be opened or closed as the occasion demands. The liquid manure tank and manure clamp should be at a reasonable distance from the cowshed.

Much time and labour can be saved in cleaning out and feeding by the fitting of carriers running on an overhead rail from the cowshed to the fodder store and manure clamp.

Cows' Drinking Water.—An abundant supply of drinking water, which is available at all times, is of material advantage. Cows in milk require large quantities of water, and it is obviously better that they should be able to drink when they want to do so rather than wait for a fixed hour of watering. A separate small trough for each cow is the ideal arrangement, as the danger of the spread of colds, etc., from cow to cow by water is eliminated. Such troughs are made as standard fittings by firms which specialise in cowshed fittings.

If this arrangement is not possible a concrete trough, running the length of the shed and immediately behind the mangers, may be installed. An outlet to permit of regular cleaning should be provided.

Washing of Hands.—Facilities for the washing of the milker's hands before the milking of each cow must be provided. All that is really necessary is a tap, a pail of water, soap and clean towel. A hand basin near the milk tip is an admirable arrangement as each milker can then wash his hands before returning to milk the next cow.

Equipment Used for Milking.—The washing of the cows is made very much easier if the hair on the flanks and udders is kept short. An ordinary pair of hand clippers should, therefore, form a part of the equipment of every dairy farm.

Milking Pails --Because of the great reduction in the amount of visible dirt which is found in milk taken into covered or domed pails, these are coming into much more general use. There are many types of such pails on the market, but the essential feature is a small opening measuring about 7 in. by 5 in., which is set as nearly vertical as is practicable. Every part of the interior of the pail must be readily accessible for cleaning, and those pails which are free from seams and crevices should be chosen. In order to facilitate cleaning some types of pail have the domed top detachable. All covered pails may be tared to act as weighing pails by adding lumps of solder to the bottom: this procedure avoids the necessity of pouring milk from the milking to the weighing pail.

Milking Stools.—The usual type of wooden milking stool requires constant attention if it is to be kept clean, and is liable to split if sterilised by steam. These may now be replaced by an aluminium stool which is easily cleaned and may be safely sterilised by steam.

The Milk Room.—In view of the benefits of refrigeration in prolonging the keeping qualities of milk all modern dairy farms are now equipped with facilities for cooling the milk. This should be carried out in a small building reserved solely for the purpose. Unless it can be separated from the cowshed by a sound wall the milk room should not be under the same roof as the cowshed. Nevertheless, it should not be at such a distance from the cowshed or milking shed as to constitute a tax on time and labour in carrying the milk. Care should be taken to avoid any position which is exposed to such sources of dust as the stack yard or food cutting and mixing barns.

There is the same necessity for ample light and ventilation in the milk room as in the cowshed, and at least one window should give a good view of the cooler without the necessity for entering the room.

Floor and Walls.—The floors and walls must both be constructed of material such as cement, which can readily be washed. If the whole of the walls are not cemented, the part immediately behind the cooler should be cemented to the full height of the wall, and the remainder carried to a height of 4 ft. 6 in. The ceiling should be flat and easily cleaned. All drainage should be carried to the outside, and on no account should inside traps be fitted.

Outside Receiving Tank.—Traffic in and out of the dairy should be as little as possible. An outside receiving tank with a hinged cover and connected by a short length of movable piping to the strainer inside will avoid the necessity for entering the dairy with each pail of milk. The tank is approached by two or three brick or cement steps, and is protected at the sides and above by a small gable.

Dairy Equipment: *The Cooler.*—Since the cooler is one of the most difficult pieces of dairy farm equipment to keep really clean, care should be exercised in its selection.

Those coolers in which the corrugations are so close together as to render cleaning difficult should be avoided. Many coolers are now made with detachable metal covers, which prevent the contamination of the milk from the air. The movable metal strainer which fits into the top trough of the cooler is unnecessary and is difficult to clean.

The Strainer.—Straining of the milk is a necessity even on those farms on which great care is taken to exclude visible dirt. Nothing has yet been found which is better than good cotton-wool discs. These have the merit of cheapness, and can be discarded after each milking. Filter cloths are also good, but there is always the danger that they may escape efficient washing and sterilisation.

Churns.—The type and construction of the railway churn are matters of great importance, since many hours are often occupied by the carriage of milk by rail. Ventilation holes have been shown to be not only unnecessary but undesirable, since they permit contamination of the milk by dust and rain.

The ten or twelve gallon churn is preferable to the seventeen gallon churn, as they are much more accessible for cleaning purposes and take up less space in transit, particularly when the handles are set vertically instead of horizontally. Churns with no seams are now upon the market, and still further reduce the labour of cleaning. Insulated churns, which keep the milk cool upon its journey, can also be obtained, and it may be that there is a future for this type of churn.

The Sterilising Room.—Unsterile dairy utensils of all kinds are probably as much responsible for the premature souring of milk as the contamination received during milking and subsequent handling. This has been realised by many farmers who are now installing sterilising equipment of various types. If possible the washing up and sterilising should be done in a small separate room which may be under the same roof, but ought to be separated from the dairy.

Simple Steam Steriliser.—For small herds, up to 15 cows, the simple steam steriliser is an economical and efficient means of sterilising the utensils. In this apparatus steam is generated by two Primus oil stoves from a shallow pail of water which is provided with an insulated cover fitted with a short pipe acting as a steam duct, which is used for sterilising churns. This cover is replaced by a galvanised iron steaming box for sterilising the cooler and the rest of the utensils. Mr. Wilks, of Bewdley, Worcestershire, finds that with this apparatus he can sterilise the utensils necessary for a herd of from 20 to 25 cows at a cost of 3s. per week for fuel.

The Converted Farm Copper.—The ordinary farm copper may also be used successfully for sterilising purposes. A hole is bored in the existing lid and a short length of 2-in. piping inserted. This serves for steaming churns and pail. For sterilising the rest of the utensils the lid is replaced by a galvanised iron tank with a perforated bottom. The copper is filled about one-third full with water, which must be kept vigorously boiling throughout the steaming process.

A simple and effective steaming outfit at a small cost has recently been put on the market. It consists of a boiler, which yields 35 gallons of hot water for washing up, in addition to the necessary steam, and a large galvanised iron tank, fitted with a thermometer, for steaming churns, pails, cooler, etc.

Pressure Boilers.—Many firms make excellent small-pressure boilers, which are necessary for the larger farms. If possible the boiler should be in a small separate shed in order to avoid the dust of stoking. Accompanying these are steaming chests in galvanised iron on the floor of which there is a wooden rack which permits of drainage. A tank measuring 4 ft. 6 in. by 2 ft. 6 in. by 2 ft. 9 in. should provide the necessary accommodation for the utensils required for a herd of as many as sixty cows.

Whatever method of raising steam is chosen, it is necessary to see that the temperature is controlled by the use of a thermometer. For efficient sterilisation a temperature of 210 deg. F.,

maintained for fifteen minutes, should be aimed at. Hot and cold water troughs are necessary for washing purposes, and are preferably made in galvanised iron. Wooden tanks are not satisfactory, as they are difficult to clean and impossible to sterilise.

STUDENTS' COMPETITIONS AT AGRICULTURAL SHOWS.

ALEX. GREGG, B.Sc. (Agric.), N.D.A.,

Cornwall County Council.

SINCE the war one branch of the system of agricultural education in Cornwall has excited a good deal of interest and favourable comment among the farming public, namely the students' competitions at agricultural and fat stock shows.

The competitions originated many years ago as a means of advertising the work of the agricultural classes conducted throughout the county and have developed to an extent little thought of when they were first introduced.

A typical list of competitions such as those conducted at the fat stock shows at Truro, Helston and Wadebridge gives a good idea of their scope. There were eight as follows:—

1. Judging a fat steer.
2. Judging a long-woolled sheep.
3. Judging a utility hen.
4. Judging six roots, either mangolds or swedes, and six potatoes.
5. Judging samples of wheat, barley and oats.
6. Identifying and naming grass, clover and weed seeds (pure) and naming grass, clover and weed seeds in a mixture (10 species in each case).
7. Identifying and naming grasses, clovers and weeds, 20 species.
8. Naming and valuing foods and manures.

The whole of the competitions with the exception of the last three are judged by points.

At the agricultural classes the points are discussed and explained to the students and class sheets distributed giving the points to be looked for in detail. At the competition a bare skeleton without any explanation is used as a score card. The class sheets of the points of a fat steer and the mangold are given for comparison with the score cards used at the shows.

STUDENT'S SCORE CARD (CLASS SHEET).
POINTS OF A FAT STEER.

<i>Scale of Points.</i>	<i>Marks.</i>	<i>Student's Marks.</i>
GENERAL APPEARANCE, stylish and showing good quality... ..	8	
HEAD, broad between the eyes, flat across the crown, muzzle broad, full, distinct and dewy; mouth large, jaw wide, nostrils large; eyes large, placid and clear; horns fine and symmetrical, set on the crest of the head; ears full and sensitive, of fine texture, well covered with hair	10	
NECK, medium length, full at the "neck vein" or "shoulder vein," broad, but fine and tapering towards the head, straight from the shoulder top to the roots of the horns		
SHOULDERS, well covered with flesh and laid back over the ribs, the shoulder blades adhering closely to the trunk; shoulder points fine... ..	8	
CHEST, full, wide, deep and massive, girth large, crops full	6	
BACK, broad throughout its length, smooth and even. Forearm and leg straight and short, leg bones dense and strong though smooth, legs well under the body	12	
BODY, long, deep, equally balanced before and behind. Frame well and equally covered with firm flesh, especially in the regions of the best cuts, not patchy on the hooks, tail-head, rump, shoulders or other parts. Ribs thickly fleshed, well sprung and deep. Trunk should resemble as nearly as possible a parallelogram; the under and upper lines straight and parallel	15	
HINDQUARTERS, full and well packed, lengthy from the hook bones to the pin bones; rump wide and even, tail-head smooth not patchy; hips smoothly covered, thighs broad, thick and well down towards the hocks; twist or inner thigh full, deep and plump. Loin thick and broad. Flank full and deep, even with the underline	16	
SKIN, moderately thick, pliable and mellow to touch. Hair soft and abundant, covering all parts	6	
TAIL, set on well back and falling perpendicular	6	
LINES of the body flowing, not sharp. Carriage stylish	6	
TOTAL	100	

All classes are open to farmers but so far only students have entered and at a convenient centre as many as 200 entries are not uncommon, mainly from students who are in their second or third year course, although the steer and sheep classes contain a number from the first year course. The entrants come from all parts of the county to take part and there is keen rivalry between the centres.

The show society, after consultation with the agricultural organiser and his staff, draw up the list of classes, the prizes to

STUDENT'S SCORE CARD USED IN
COMPETITIONS.

Competitor's Marks.		Competitor's Number.
<p>TRURO FAT STOCK SHOW STUDENT'S SCORE CARD FAT STEER</p>		
JUDGE :—		
Scale of Points.	Maximum Marks.	Student's Marks.
1. GENERAL APPEARANCE	8	
2. HEAD	10	
3. NECK	7	
4. SHOULDERS	8	
5. CHEST	6	
6. BACK	12	
7. BODY	15	
8. HIND QUARTERS	16	
9. SKIN	6	
10. TAIL	6	
11. LINES AND CARRIAGE	6	
TOTAL	100	

be offered, and fix a nominal entrance fee (all of which are entered in the show schedule), and appoint the judges and the stewards.

In order that justice should be done to the student competitors some of the judges have attended the courses when the points of their particular competition were being discussed. Recently past students, who have been prominent prize-winners in previous shows, have been judges in conjunction with some well-known farmer. Both plans are excellent, as either method ensures the scores being compiled from the educational view point.

The competitions commence practically as soon as the show opens: this is very necessary as a good competitor who goes thoughtfully over the points, will not have finished much before the lunch interval.

In the classes for plants, weeds and seeds, the judges select and number 10 samples of plants, 10 samples of pure seeds and make a mixture of 10 seeds, and the competitors have to fill in the names on the numbered place of the corresponding card.

Feeding Stuffs and Manures.—The public take great interest in the foods and manures class. The cards used at the 1923 show at Truro are shown on p. 354.

It will be noticed that the competitors must identify six manures and six foods from their appearance and physical characters. Three other manures are given with their compositions, and it is required to calculate the money value of these

STUDENT'S SCORE CARD—(CLASS SHEET).

MANGOLDS.

<i>Scale of Points.</i>	<i>Maxim. Points.</i>	<i>Student's Marks.</i>
1. TRUENESS TO TYPE—Of Globe, Tankard or Long Variety. Of correct colour	15	
2. SIZE—Of moderate size only—density and regularity of form must not be sacrificed to size	20	
3. SHAPE AND FORM—Clean and regular in outline, no cracks or crevices, single tap-root; free from fangs; neck small and only moderate amount of foliage	20	
4. INTERNAL APPEARANCE—Flesh dense, no hollow spaces or tendency to sponginess, rings numerous with narrow interspaces	25	
5. SPECIFIC GRAVITY AND DRY MATTER—Should be high (often low in very large roots)	20	
TOTAL	100	

by the usual unit value method and award marks for their condition. In addition the competitor must fill in the price per unit and comment on the condition of three foods whose prices and starch equivalents are given.

After the judges have completed their score cards, and the stewards collected those of the competitors, comes the onerous task of correction and checking of scores, with the final awarding of prizes. It is no unusual occurrence to have a correct score by more than one competitor in which case the judge either divides the prizes between those tying, or if time permits sets a further test. The results are given to the society's official and the names of the winners posted on a prepared sheet.

All the competitions with the exception of the judging of the animals are conducted at a section of the show set apart for the purpose, and with each class is displayed an enlarged blank score card. When the competitors have finished, the whole is open to the public for inspection. The county agricultural staff are present to explain any points that arise during the criticism and comment that follow and in this way considerable advisory work results. the staff coming into contact with agriculturists whom they do not at other times reach.

STUDENT'S SCORE CARD USED IN
COMPETITIONS.

Competitor's Marks				Competitor's Number	
<p>TRURO FAT STOCK SHOW STUDENT'S SCORE CARD MANGOLDS</p>					
JUDGE :—					
Scale of Points				Maximum Marks	Student's Marks
1. Trueness to Type				15	
2. Size				20	
3. Shape and Form				20	
4. Internal Appearance				25	
5. Specific Gravity and Dry Matter ...				20	
TOTAL				100	

Competitor's Marks.		Competitor's Number.				
TRURO FAT STOCK SHOW STUDENT'S SCORE CARD FOODS.						
Judges :—						
NAME THE FOODS NUMBERED						
1 _____	4 _____					
2 _____	5 _____					
3 _____	6 _____					
Give the FOOD VALUE and VALUE PER UNIT and COMMENT on the CONDITION of the following FOODS						
	Price per ton	Manurial Value	Food Value	Starch Equivalent	Value per Unit	Condition
7	£6 10 0	£1 5 0		61		
8	£13 0 0	£2 13 0		71		
9	£9 0 0	£1 10 0		78		

Competitor's Marks		Competitor's Number.			
TRURO FAT STOCK SHOW STUDENT'S SCORE CARD MANURES.					
Judges :—					
NAME THE MANURES NUMBERED					
1 _____	4 _____				
2 _____	5 _____				
3 _____	6 _____				
Give the VALUES of the following MANURES and MARKS for their CONDITION					
	Nitrogen	Phosphates	Potash	Value	Condition, Max. Marks, 8
7	5.5 %	24.0 %	3.0 %	£	
8	3.25 %	18.0 %	2.5 %	£	
9	1.5 %	26.0 %	2.0 %	£	

ORCHARD IMPROVEMENT INSTRUCTION IN HEREFORDSHIRE.

A. J. MANNING,

Hereford County Council.

IN 1912 the Agricultural Education Sub-Committee of the Herefordshire Education Committee inaugurated a scheme for improving the cultivation of the orchards of the county, and to induce the occupiers of the farms of the district to do justice to their trees and raise the standard of their produce to the pitch of perfection so easily attained in Herefordshire, even when a moderate amount of care, skill and attention is expended.

The scheme, in brief, was to carry on, for five years, annual competitions in orchard management. As a basis from which to start, the orchards were awarded points before any work was done on them, and they were visited twice each year by two local fruit growers, the late Mr. G. P. Berry, of the Ministry, and the County Horticultural Instructor. Such points were given above the original as it was considered the improvement warranted. Two medals were awarded each year to the competitors who showed the greatest and next greatest improvement; also a money prize in each case to the workmen who had had the care of these orchards. At the end of the five years it was intended that the occupiers of the orchard showing the greatest improvement should be presented with a very substantial piece of plate. Unfortunately, the cataclysm of 1914 upset the whole of the arrangements, and the scheme had to be abandoned.

One redeeming feature was the discovery that, notwithstanding the fact that Herefordshire had been almost continuously providing instruction in horticulture and fruit culture right from the inception of technical education, skilled pruners were almost impossible to be found outside the various fruit plantations of the county.

As soon as the results began to be noticeable in the orchards which were entered in the improvement competition, occupiers of the neighbouring farms began almost bombarding the agricultural education staff for names of men capable of pruning their orchards, with the result that regrets and apologies had to be sent in almost every case instead of names.

On the Armistice being signed, the writer was instructed by the Agricultural Education Sub-Committee to draft a scheme for the further development of horticultural education in the county, and, amongst other subjects, the improvement of grass orchards

came in for some very detailed suggestions. Remembering the great demand for pruners a suggestion for the systematic training of suitable men was put forward and adopted by the Committee, as being likely to be of much greater value than the old-time system of giving disjointed demonstrations and lectures. Events have proved the wisdom of the change.

The scheme put forward was to take a class of about six men, preferably those who were free to take different jobs during the winter months, smallholders who had some spare time on their hands, and jobbing men of any type, if, apparently, of reasonable intelligence and capable of doing a man's work, and giving these men 10 days' training of from $4\frac{1}{2}$ to $5\frac{1}{2}$ hours each day in pruning the different types of trees found in the average grass orchard of the county. This training was to be, if possible, followed up by instruction in grafting, spraying (in the seasons), and picking, grading, and packing the fruit.

There has never been any difficulty in finding pupils. In fact, in almost every case more have handed in their names than could be dealt with. This has enabled the instructor to select his students, and, in several cases, enough suitable pupils have clamoured for instruction to justify the holding of a second class in the same neighbourhood. If no other applications for classes reach the agricultural education office there are enough names on the waiting list to keep the staff fully occupied for the next two winters.

Arrangements for Starting Classes.—When an application is received from a farmer for a class he is told that he must make himself responsible for providing the pupils, he is also told what class of man is required, and the conditions on which the pupils are accepted. He is asked to impress on the men that they must undertake to put their knowledge and services at the disposal of people in their respective districts; they must attend the classes with reasonable regularity, and on the last day of the class must be examined in practice, and a knowledge of the reasons underlying such practice. If they pass the examination they are awarded a scholarship grant of 6d. per hour for each hour of attendance made. In case of failure to satisfy the examiner no award is made to them. The fact that their time would be lost to them in case of failure was thought to be a great inducement to careful attention to their instruction, and the writer has very little doubt that such is the case.

The instruction so far given has been entirely confined to standard trees, and—with one exception—on purely grass

orchards. So far as possible farm orchards having the greatest variety of types, sizes, and ages of trees, have been selected for teaching purposes. Each pupil is provided with a set of tools for which he is made responsible for the duration of the class. These tools are a curved Grecian saw with an eighteen-inch blade, one 10 ft. and one 8 ft. standard pruner, and he is taught to keep these clean and keen.

Method of Instruction.—On the opening day of the class, the theories underlying pruning are as carefully and thoroughly as possible instilled into the pupils. They are also shown how to use the tools in a proper manner, and above all, how to avoid doing damage with them if improperly used. When they appear to have a fair idea of the theory they are taken to some small tree which it is easy to prune, and asked to watch a demonstration by the instructor; criticise his work as much as they like; ask as many questions as they wish; and as the tree begins to show up in part its final and finished form, point out what they think should be cut out. By following this method of teaching it is found that the pupils readily acquire a keen sense of the necessary shape the finished tree should have. The next step is to take two trees as nearly alike to that on which the demonstration has been made, and as near together as possible. One half the class is placed to work in each tree, and each party is allowed to discuss the work as it proceeds, and the advisability, or the contrary, of cutting out any branch. It is found that although the first day's work does not amount to very much, the knowledge gained has been very considerable. On the second day, the students are worked in pairs, and usually after that it is found that individual working enables the instructor to give the necessary extra attention to any who appear to be less quick in grasping knowledge than their fellows. Working on these lines this past season, with a class of seven pupils, 164 half-standard trees of Bramley's Seedling, Newton Wonder and Lord Derby were satisfactorily pruned in six hours.

Each succeeding day larger trees are dealt with, and gradually the pupils progress until about the sixth day there is no further selecting done. The pupils are set one in each row and have to take any trees in their own lines as they come. In many cases these trees have a spread of 30 to 40 ft., and are absolutely matted with years of growth of tangled and wattled shoots. Some idea of the type of tree may be gained when it is stated that the first of these classes pruned a tree of Cummeys Norman having a spread of the length of a cricket pitch!

The examination is held on the last day of the class, and usually one tree is selected for the purpose which will keep each pupil busy for the whole of the time allotted for a day's training; usually about 5 hours. Some idea may be gained of the type of trees usually selected from the accompanying illustrations Fig. (1) commencing work; and Fig. (2) one tree finished. In this case two trees per pupil were set as a task for the examination and were completed in 4 hours.

Grafting.—During the pruning instruction any of the common and least useful cider varieties, or any useless varieties found (locally known as kernels) are, if the owner wishes, beheaded with a view to regrafting in the following spring with more useful varieties which may, in some cases, be the better varieties of cider apples, but are, more generally, commercial apples. Bramley's Seedling and Worcester Pearmain are found to be two first-class varieties for this purpose, and, to a somewhat less extent, Newton Wonder and Annie Elizabeth are selected. In several places King Edward has been used and promises extremely well. In one orchard in the Bosbury district are several apple trees on which upwards of 100 grafts per tree were put, and these trees are doing well and are showing signs of commencing to bear now in the third year.

The principles underlying grafting are very carefully explained and suitable shoots of the current year selected during the pruning lessons and carefully set in the soil by the pupils for their use at the proper time. Some time in May the classes are called together and shown how to make the graft, and set to practice on some spare shoots kept back for instructional purposes. When considered sufficiently skilful they are set to work on the trees. Three methods only are taught, these being very simple to make and easy to fit to any size stock from the young stock of the nursery up to the orchard giant. It is emphatically pointed out that it is wise to keep a bud at the back of the cut in case of an accident to the graft after it has been inserted in the tree, or after growth has commenced. When this bud is kept a year is saved. Binder twine is used for tying instead of raffia, being more secure. In fact, it is practically impossible for a graft to blow out when so tied. The tie is not interfered with until the second year's growth is well advanced. It is then cut through from top to bottom, but not unwrapped until the end of the season. If it is pushed off by growth, well and good; if not, it stays there. Clay is available in most parts of Herefordshire, and it is used instead of wax; in practice, it is



FIG. 1.—Class commencing work on first of 2 trees set for examination.



FIG. 2.—First tree finished and work commenced on the second at the same examination.

found to be better than wax and much more economical. Warm wax has been found to be very risky, owing to the temptation to make it too warm to save so many journeys up and down the ladder. No very special preparation of the clay is found to be necessary when binder twine is used. It is made fairly wet and thin, and rubbed well in between the wraps of the string; then not more than $\frac{1}{2}$ in. is well smoothed over the string and ends of the branches. If the coating is kept as thin as above mentioned it is very rare indeed that any falls off. It is when large lumps in thick layers are used that cracking and dropping off takes place.

Practically all the shoots which break from the cut-back branches, except in the immediate neighbourhood of the actual grafting, are allowed to grow for the first year, and somewhere about one half of these are allowed to continue for the second year.

When all shoots are prevented from growing after re-grafting a tree, there are not enough leaves produced to continue the economy of such a tree and very frequently the bark slips away from the branch during the first or second winter after grafting. This results in dead branches at least, and often in dead trees, but it is seldom that such mishaps occur when all growth is allowed to form for a time.

Effects of the Classes.—Since these pruning and orchard management classes were commenced in Herefordshire, twenty-one have been held, which means that, at least, 126 men have been trained. The benefit of this number of pruners in the county is becoming evident, and the evidence is cumulative from year to year. It is becoming noticeable in the orchards also in the greater demand for instruction in districts where none has yet been given. The call has been so insistent that during the past winter additional help has had to be obtained, and has enabled nearly double the number of instructional classes to be carried on.

There is another side to the instruction in orchard cultivation conducted in the county, *i.e.*, that in conjunction with the Winter Courses in Agriculture for Young Farmers. These courses have been conducted for many years, and two have been carried on during the past winter—the main one in Hereford, where classroom lessons in fruit culture were given on three mornings each week, and two afternoons each week were devoted to practical work.

Herefordshire is now taking up the fruit culture question from both ends, viz., with the young men who will be the farmers and fruit growers of the future, and with the men whom they will employ. There can be very little question that instruction correlated in this way for a few years will bring the orchards of Herefordshire to the position undoubtedly held a century or so ago, and such as, with persistent effort, can easily be attained again—that is, the finest in the country.

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THE CULTIVATION OF CHERRIES.

II.

A. H. HOARE,

Ministry of Agriculture and Fisheries.

II.—**SOUR CHERRIES.**—The sour or cooking cherries comprise the Flemish Red, Kentish Red and Morello varieties.

As a class they are more amenable to the ordinary plantation type of cultivation than sweet cherries, and for this reason are often found interspersed with other fruit in permanent plantations.

Large blocks of these varieties are often planted by themselves and on suitable soil the trees are prolific croppers.

Soil and Situation.—Sour cherries will succeed on any well-drained loose land and thrive particularly well on sandy gravels, brick-earths and flinty lands or chalk.

They are not quite so particular as to situation as sweet cherries and will even do well with a north aspect. Frost pockets and steep valleys should, however, be avoided.

Propagation.—Nearly all the sour cherries are grown either as half-standards or bush trees. The Mahaleb stock has been a popular one in the past, but the Common cherry, known as *Cerasus austera*, is often used. The Gean is also a suitable stock. There is no really dwarfing stock for cherries and it hardly matters which is used.

Planting and After Treatment.—Whether planted triangularly or on the square half-standards are usually placed at least 15 ft. apart each way and bush trees 10 ft. or 12 ft. each way. Bush trees should be planted on the square.

Sour cherries fruit on the young wood and, after the half-standard trees are shaped, pruning is not necessary. They are, however, not so intolerant of the knife as the sweet varieties and do not gum so freely. They may therefore be pruned, to keep them shapely or within bounds, if desired.

Bush trees also need no pruning after planting. The trees respond to good feeding, as in the case of sweet cherries.

Picking and Marketing.—Sour cherries hang better after ripening than do the sweet varieties, and the birds do not take them so freely. Like the sweet cherries, sour varieties are usually marketed in half-sieves or "quarters" (pecks).

Sour cherries as a class are mostly sold for culinary purposes, a certain quantity of Morellos being taken for the manufacture of cherry brandy. In addition to the demand for the fruit on the market for retailing there is a big demand from preserving firms for bottling purposes.

Varieties of Sour Cherries.—**KENTISH RED.**—(Middle July). *Fruit* medium size, round, dark red, transparent, with very tender, juicy, acid-flavoured flesh. A good cooking cherry and preserves well. *Tree* of medium growth and does well on half standards or bushes. Bears freely if planted with others, particularly Flemish Red. Self-sterile.

FLEMISH RED.—(End of July). This variety is the nearest approach to the wild cherry, *P. cerasus*. It resembles Kentish Red but the *fruit* is smaller and a little brighter red. *Tree* makes compact growth, is less drooping than the Kentish Red, and does well as a bush. Very free-bearing and self-fertile. Will succeed where the other varieties do not thrive so well.

MORELLO.—(August-September). *Fruit* large, inclined to heart-shaped, flattish, dark red or black when fully ripe. Flesh soft, juicy with briskly acid flavour. *Tree* is of a spreading, pendulous habit of growth, and succeeds as a standard, half standard or bush. It is remarkably prolific, self-fertile, and the fruit will hang a long time.

There are really two varieties of Morello in existence. The old-fashioned, smaller variety is most sought after for the manufacture of cherry brandy. The Morello is the best of the sour cherries for all purposes.

DISEASES AND PESTS OF CHERRIES.—Cherries are liable to a good many diseases and pests, the principal of which are described below.

Brown-Rot.—The blossom, shoots and fruit of cherry trees are attacked by the brown-rot fungus, *Monilia cinerea*, var. *pruni*, which causes considerable damage in wet, cold seasons. The fruit may also be attacked by the allied species *Monilia fructigena*. The disease varies in intensity with the season and is difficult to control in cherry trees on account of their size. It is specially important that no mummied cherries should be allowed to remain on the trees, as these constitute a sure means of carrying the disease over from year to year.

The Kentish and Flemish varieties are very susceptible to Brown-rot attacks and some of the sweet varieties are more subject than others.

For further particulars of this disease and its control Leaflet No. 367 (*Wither-tip and Brown-rot of Plums*) should be consulted.

Cherry Leaf Scorch.—This disease has the effect of withering up the leaves on the shoots. They remain hanging there throughout the

winter and may be seen as late as May. It is caused by the fungus known as *Gnomonia erythrostoma*. The dead leaves which hang on until the following spring should be removed and burnt in the case of all trees in which they are readily accessible, since they are the means by which this fungus is carried over from season to season. For larger trees two sprayings with Bordeaux mixture, one just before the blossoming occurs and the other directly afterwards, have been found to give effective control.

Silver Leaf.—This disease has made heavy attacks on cherries during the past few years. Napoleons and Turkey Hearts are especially susceptible to attack, as also are all the sour cherries. Trees which have been headed back (pollarded), or headed back and grafted, are also very liable to attack. Care should be taken to see that no wounds are left for long uncovered, and grafting operations should be expedited as much as possible. For further particulars of this disease and its control see Leaflet No. 302 (*Silver Leaf in Fruit Trees*).

Witches' Brooms.—Another serious disease, which is caused by the fungus *Exoascus cerasi*, results in the formation of the so-called "Witches' Brooms." The fungus mycelium is present in the branches and stimulates them to produce numerous twigs which together take on a form roughly comparable to a loose broom. The leaves borne by these abnormally branches twigs are also penetrated by the fungus which ultimately produces countless numbers of spores on their surfaces. Such leaves are usually wrinkled or crumpled and reddish in colour. These brooms are always barren and since they serve as centres from which the disease is spread they should be promptly cut out and destroyed by fire.

An allied fungus, *Exoascus minor*, causes a blister or curl of cherry leaves somewhat similar to peach leaf-curl, but this trouble is not common.

Gumming.—Gumming is a trouble which affects some varieties of sweet cherries more than others. Trees upon which the knife has been used tend to gum excessively. If the gumming is very bad and persistent it is generally taken as a sign of an unhealthy condition of the tree, but there seems to be no remedy. The cause of gumming in cherries is obscure, but it does not appear to be due to any fungus or other parasite.

Winter Moths.—The chief insect pest of cherries is the winter moth. All standard and half standard trees should be grease banded to prevent the ascent of the females. The bands should be maintained in an effective condition throughout the year and replaced annually in fresh positions on the trunks of the trees. When, however, this is neglected and caterpillars are found to be feeding in the spring, they may be destroyed by spraying if the trees are not too large to admit of it. See Leaflet No. 4 (*Winter Moths*).

Lackey Moths.—Periodically the attacks of the caterpillar of this moth become epidemic and cherries which cannot be sprayed early with lead arsenate may then suffer severely. Under these circumstances mechanical measures such as tearing down the webs and the collection in winter of the egg bands may have to be carried out—at a cost which exceeds that of an efficient high power spraying installation. See Leaflet No. 69 (*Lackey Moth*).

Cherry Black-Fly.—This black aphid (*Myzus cerasi*) is another serious insect pest. In some seasons it swarms over the shoots and under the leaves, causing the latter to curl up. The honey-dew issuing from this pest gums up the leaves and if it gets on the fruit spoils it. The leaves and shoots are often killed outright if the attack is bad.

The only remedy is to spray early with a good nicotine insecticide or soft soap and quassia, providing, of course, the trees are not too large for spraying. The successful spraying of cherry trees depends largely on the plant employed. With an efficient power plant trees of any size may be sprayed thoroughly.

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COUNCIL OF AGRICULTURE FOR ENGLAND.

THE Thirteenth Meeting of the Council of Agriculture for England was held on May 22nd, 1924, at the Middlesex Guildhall, Westminster. The Chair was taken by Mr. George Edwards, M.P.

Appointment to the Agricultural Advisory Committee for England and Wales.—At separate meetings of the Minister's members and County and Borough Agricultural Committees' members held previously to the full Council meeting, the following members were elected to the Agricultural Advisory Committee: (1) Mr. Robert Hobbs, of Kelmscott, Lechlade, Gloucester; (2) Mr. James Donaldson, of Brightwell Baldwin, Wallingford, Oxon; (3) Lt.-Col. Sir Merrik Burrell, Bart., C.B.E., J.P., of Knepp Castle, Horsham; (4) Mr. J. R. Spraggon, of Blaydon Burn House, Blaydon-on-Tyne. It was announced that a further vacancy had been filled by the Minister by the election of the Hon. E. G. Strutt, C.H., of Whitelands, Hatfield Peverel, Essex.

Statement by the Minister.—In the course of the Minister's statement, which covered the period which had elapsed since the last meeting in February, he stated that the decline in the number of cases of foot-and-mouth disease had been from 99 in the week ended 2nd March to 9 in the week ended 22nd April, since when the weekly averages had been 9, 11 and 13. Improvements had been made in the methods of disinfection of railway trucks, vans, etc., and special inspectors had been appointed to supervise the working of a new Order on the subject.

The Minister invited the special attention of members of the Council to the Ministry's exhibit at the British Empire Exhibition, and also to the agricultural films which had been

prepared and were being shown there. In regard to drainage work for the benefit of the unemployed, the number of schemes carried out last season was 399, of which water supply schemes numbered 71. The immediate cost to the State had been £276,000, of which £33,000 was recoverable, and the total expenditure represented by the schemes was £391,000. The number of men who were being employed upon them at the end of the season was 7,000 per week. Schemes for next autumn and winter were being prepared on the assurance that further Government money would then be available for the purpose. The Minister also announced that a Committee was being set up "to advise as to the administration of any public monies that may be made available for the assistance of Agricultural Co-operation or Credit."

With regard to the suggestion in the Linlithgow Report that the public and the farmers should interest themselves more in new types of wheat, the Minister referred to the research work being done at Cambridge and other stations, and especially to the work of Professor Biffen at Cambridge. "Yeoman" wheat was very good and was being further improved upon by other types. Prices had improved by the demand which was growing amongst millers for these better wheats, and the public should assist by asking for bread made from British flour from them, which would be found to be very good. He had himself tried it in his own house, and friends without knowing which was which had pronounced in favour of British bread over the ordinary bread supplied. He was not ashamed to confess to a sentimental preference for British food. In reply to a question by Sir Douglas Newton, the Minister said that the Department would not be able to give the full results of the reported discovery of the germ of foot-and-mouth disease on the Continent, but that they had been promised at an early date. A cordial vote of thanks to the Minister for his address was put to the meeting and carried unanimously.

Sale, etc., of Land used for Allotments.—Mr. J. Forbes moved a resolution to the effect that where land had been purchased by local authorities for use as allotments they should not be permitted to sell it or dispose of it for any other purpose unless they had the consent of the Ministry of Agriculture and Ministry of Health. The resolution was seconded by Mr. Woodhead (Yorks), and, in the course of the discussion, Mr. W. R. Smith, M.P. (Parliamentary Secretary of the Ministry of Agriculture) pointed out that it had been agreed at another Committee

that the recommendation should rather be "with the consent of the Ministry of Health after consultation with the Ministry of Agriculture." Mr. Smith said that legislation would be required to give effect to the proposal, and that there was no present prospect of this being practicable. The resolution was passed.

Further Compensation for Foot-and-Mouth Disease.—Mr. W. McCracken (Cheshire) moved a resolution to the effect that the compensation paid to farmers for cattle destroyed through foot-and-mouth disease should be supplemented to meet at least a portion of the loss due to the suspension of production and earnings, and to the increased cost of replenishing stocks, giving special attention to the circumstances of the earlier outbreaks when valuations were relatively low; also that farm labourers should be compensated for loss of employment and wages due to the slaughter of herds. The resolution was seconded by Major H. E. Wilbraham (Cheshire). Mr. Donaldson (Oxford) said that there had undoubtedly been cases of individual hardship in Cheshire, but that the matter must be looked upon broadly. If the cart were overloaded, there was a likelihood that the wheel might come off. As it was, a very large amount of money was being spent in the eradication of the disease and in compensation. Mr. W. R. Smith, M.P., said that legislation would be required to give effect to any such proposal as had been made, and that probably the best way to deal with the suggestion would be to refer it to the Departmental Committee now sitting which was reviewing the circumstances of the present outbreak. Mr. Owen Webb (Cambridge) said he could not support the resolution, adding that the losses incurred by farmers who had had no disease amongst their stock through being unable to market their stock were far greater than the amounts paid in actual compensation. The motion was put to the meeting and lost.

County Councils and Land Drainage.—Mr. J. R. Spraggon (Durham) proposed a resolution that in view of the urgent need of land drainage for the reclamation and improvement of agricultural land H.M. Government be requested to bring in legislation giving county councils the necessary powers to deal with the matter. He said that much of the land in the country was not producing anything like its proper amount of food through lack of proper drainage. Some occupiers did not keep their ditches, watercourses and outfalls properly cleansed, and there was little use in one person cleaning out his ditches, etc., if his neighbours below him did not clean theirs out also, and

so give him a proper outfall for the water. Two counties, Lancashire and the West Riding of Yorkshire, had promoted private Acts of Parliament to give them powers to deal with such matters. The problem, however, was a national one, and every county ought to have similar powers. Lord Bledisloe seconded the motion and said that thousands of acres were yielding less than half their potential output through lack of effective drainage, and drainage problems could not be dealt with piecemeal. He thought that legislation on the subject would be non-contentious and would have the support of both Houses of Parliament. Capt. Hotchkin (Lindsey) and other members also supported the resolution, and Sir Francis Floud (Permanent Secretary of the Ministry of Agriculture) stated that the Department were quite in agreement with the object of the resolution, and were as a matter of fact actually in communication with the County Councils' Association as to the precise lines of fresh legislation. He added that much could be done under the existing powers and under the special unemployment schemes. It was, he said, generally agreed that no part of the funds which had been devoted by the Government for the relief of unemployment had been more usefully expended than those applied to land drainage. It had recently been agreed that County Committees could retain their drainage staff during the summer so that schemes for autumn and winter might be prepared during the summer months. If full advantage were taken of this and of the power given to County Councils under Section 16 of the Land Drainage Act it ought to be possible to deal with the matter effectively.

Resolutions Passed at Last Meeting.—Sir Francis Floud reported, on behalf of the Ministry, the action which had been taken by the Ministry upon the two resolutions passed at the last meeting which called for such action. The first was to the effect that legislation was required to provide for one authority only for the control of animal diseases in each geographical county. The Ministry was in full sympathy with the object of the resolution, but legislation would be required to give effect to it. That matter was now under consideration with the Ministry of Health and the Secretary for Scotland. It raised a difficult question in regard to the relationship between county boroughs and county councils, and the Ministry also wished to consult the County Councils Association and the Association of Municipal Corporations upon it. It was obvious that no legislation was practicable in the present Session, but

the Ministry hoped to make an advance later in the year. The second matter was the resolution recommending that the Minister should invite the Directors of the Animal Nutrition Institutes at Aberdeen and Cambridge to report on the further facilities which were required for the purpose of research of animals in Great Britain. Within the last few days, Professor Wood and Mr. Orr, the Directors concerned, had made a report which the Ministry were considering. The report would be handed over to the Standing Committee of the Council with the observations of the Ministry upon it, and when the Standing Committee had considered it, they would no doubt bring it before the Council.

Resignations of Certain N.F.U. Members.—The Right Hon. F. D. Acland, M.P., Chairman of the Standing Committee of the Council, moved the acceptance of the report from the Standing Committee on the subject of these resignations.

Report on the resignation from the Council of certain of the National Farmers' Union Members.

The Standing Committee has had under consideration the question of the resignation of 25 members of the Council who are also members of the National Farmers' Union. It regrets very much that so many members of the National Farmers' Union on the Council have resigned, and wishes to make it clear that the statement that the members have resigned because the Council claims to express "the authoritative opinion of agriculturists" cannot be correct, as the Council has made no such claim. The phrase occurs in paragraph 7 (b) of the report of Lord Clinton's Committee, which was adopted by the Council at its last meeting. In this report the duties of the Standing Committee are outlined and the paragraph reads as follows:—

"7 (b) To keep in close touch with the Agricultural Advisory Committee for England and Wales and to ascertain from time to time whether the Minister of Agriculture desires to set down for discussion by the Council one or more subjects on which he wishes to gather the authoritative opinion of agriculturists."

This statement in no way suggests that it was the intention of Lord Clinton's Committee to propose to the Council that it should assume a new position. No change whatever has, in fact, taken place in the attitude of the Council, whose duty it still is, as it has been since its formation, to carry out the role and functions laid down for it in the Ministry of Agriculture and Fisheries Act, 1919.

The formation of the Standing Committee marked only the desire of the Council that it should be put in a position to discharge its statutory duty with greater efficiency, and in the opinion of the Standing Committee it is a matter for regret that this action should have been made the occasion for resignations.

The Standing Committee believes, however, that the Council will desire to express its agreement with a statement recently made on behalf of the National Farmers' Union on one point. Mr. Robbins stated at the meeting of the Council of the Union

held on April 16th that recent events had "proved their whole case, namely, that the National Farmers' Union . . . never had the right to instruct any member of the National Agricultural Council how he was to vote." The Standing Committee concurs in the view that members of the Council do not serve as delegates voting under instructions, but, on the contrary, are called upon to exercise their own judgment on matters coming before them.

In your Committee's view it would be a distinct change in the conception with which the Council was set up if any of those appointed, either by the County Agricultural Committees (in the exercise of their statutory duty) or by the Minister, should regard themselves as subject to the instructions of any particular organisation connected with agriculture. And the Committee trusts that the Council will record for the guidance of those who may be appointed to take the place of the members who have resigned that there has been no change since the original setting up of the Council either in this matter or in the position of the Council as representing the agricultural industry.

Mr. Acland suggested that the report be adopted, and should be sent to those County Agricultural Committees which had under their statutory duty to fill up the vacancies which now existed. Lord Clinton said he thought it a matter of serious regret to the Council that so many members of the National Farmers' Union should have thought it necessary to withdraw from the Council at a time when it was endeavouring to improve its procedure. He said he valued the Council very greatly because it was the only place where people of all classes engaged in the industry and all sections had a right to meet, and where there might be always a free expression and a free discussion of all matters. Lord Bledisloe said that the Council owed a debt of gratitude to Mr. Acland and Lord Clinton for the impartial and statesmanlike attitude they had adopted towards this problem. Nothing could be more detrimental to the future of the industry than the over-emphasis of sectional sentiment. He ventured to hope that the National Farmers' Union delegates would rejoin the Council. Colonel Courthope, M.P. (East Sussex), said he would be sorry if readers of the report went away with the impression that the Council was very humble. He believed that if the reforms of procedure which Lord Clinton's Committee suggested were carried out in the spirit put forward, the Council would be recognised as a powerful agricultural body. Mr. Donaldson (Oxon) said that as one who had had some little pressure upon him to resign from the Council he was bound to say that he thought he would be doing his duty much better by not resigning. Reforms in the Council's procedure came much better from within, and it was not right for members to run

away from their duty. The one agreed object of Council meetings was that all three parties could come together without prejudice and discuss the aims and objects of all sections.

The Chairman (Mr. George Edwards, M.P.) said that he felt most keenly the action of the National Farmers' Union at the last meeting. Their President had made a proposition that he should take the Chair, and had no doubt done it with the best of motives, but before the meeting was over he found that the leaders had organised an upsetting of the business of the Council, and the meeting was compelled to adjourn. Even now he hoped that the National Farmers' Union leaders, many of whom he knew and held in great respect, would reconsider their position and return to the Council. The report was then received and adopted, and Mr. Acland's suggestion agreed.

Interim Report on Agricultural Education and Research.—The Chairman of the Standing Committee (Mr. Acland) reported that the Standing Committee had got together some very useful and interesting information on agricultural education and research in England and Wales, but had not yet got comparable information from Scotland. It therefore proposed to postpone the report until the Committee was in a position to present a complete statement in regard to Great Britain. The Council agreed to this proposal.

Quorum.—Sir Douglas Newton, M.P. (Cambs), proposed that the Minister be asked to revise the statutory regulations and make the quorum for the Council 25 members instead of one-third (47). The quorum in the House of Commons was one-fifteenth of the total number, and he thought the present suggestion, which would reduce the one-third to about one-sixth, would be the right basis for the Council to adopt. Mr. Cross (Berks) seconded the motion, which was carried unanimously.

Elections to Standing Committee.—The Council elected Mr. James Hamilton (Lancs) and Capt. E. T. Morris, J.P. (Herts), as tenants of agricultural land, to fill vacancies on the Standing Committee.

Unemployment Insurance and Agricultural Labourers.—Mr. Dallas moved—

“That the Standing Committee of the Council be instructed to appoint a Sub-Committee (with power to co-opt) and the Ministry of Agriculture be requested to assist it with the services of their officers, and the Ministry of Labour with the services of the Government Actuary, in order to ascertain whether the basis of a scheme for unemployment insurance suitable for the industry of agriculture can be worked out, so that a further report may be presented to the Council.”

Sir Arthur Hazlerigg (Leicester) seconded, and after discussion, in which the Minister of Agriculture joined, the resolution was carried.

Weighing of Fat Cattle for Sale.—Mr. Donaldson (Oxon) moved—

“That the Council urges the Ministry of Agriculture to promote legislation to make compulsory the weighing of all fat cattle on being exposed for sale in any public market, the weight of each beast to be declared at the time of sale.”

This was seconded by Mr. James Hamilton (Lancs) and supported by Mr. H. W. Thomas (Hants), Mr. Wm. Hawk (Cornwall), and other members, put to the meeting and carried after an amendment that the word “fat” should be deleted had been proposed and lost.

Accounts of Holding Companies.—Mr. A. W. Ashby proposed—

“That the Council asks the Ministry of Agriculture to press the Board of Trade to introduce legislation to require the publication by holding companies of annual returns of profits and costs as recommended in the Linlithgow Committee Report on the Milk Industry.”

Mr. Woodhead (Yorks) seconded. The Minister of Agriculture said that the matter was receiving the attention of the Board of Trade and that they would no doubt give their best consideration to the question. The resolution was agreed to.

Development of Rural Industries.—Mr. A. W. Ashby moved the following resolution—

“That with a view to the further development of rural industries throughout the country, (1) funds should be provided to enable the Rural Industries Sub-Committee of each County Agricultural Committee to carry out the functions which it was intended to carry out, and (2) grants made to the Rural Industries Intelligence Bureau should be maintained for the present.”

Mr. Woodhead (Yorks) seconded and after discussion the resolution was agreed unanimously.

Illegality of Milk Licence Charges.—Lord Strachie moved the following resolution—

“That the Ministry of Agriculture be asked to state what steps have been taken, or will be taken, under the exemption of milk from the War Charges (Validity) Bill, to secure that farmers who were illegally deprived in four western counties of 2d. per gallon shall as far as possible have this made good to them.”

The resolution was duly seconded, and discussed. The Minister of Agriculture pointed out that Milk Charges were not now to be included in the War Charges (Validity) Bill. The money held by the Government in respect of these

charges, amounting to £105,000, would be repaid to the persons from whom it was received, namely, the distributing companies. The money held by these companies and not paid to the Government was stated to be £160,000, and the total amount involved was therefore £265,000. It had not been the farmers who had been "illegally deprived" of the money; it was the distributors. He explained the history of the matter and said that he thought the best proposal on which he could act was to suggest to the distributors that the money might be devoted to research for the improvement of the dairying industry. After further discussion, in the course of which amendments were moved, the resolution was dropped, it being agreed that the Council proceed to the next business.

State Agricultural Policy.—Mr. Robert Bilsland (West Suffolk) moved—

"That it is desirable that the Council of Agriculture for England should take immediate steps to assist the Government and the agricultural industry by framing a policy having as its objects (a) the maintenance within safe limits of the home-grown food supply, and (b) the stabilisation of the agricultural industry, and that for the purpose the Council should appoint a committee of owners and occupiers of agricultural land and agricultural workers with an instruction to prepare a policy as aforesaid and submit the same to the Council for consideration with the least possible delay."

This was seconded and the importance of the very careful drafting of terms of reference to the Committee stressed by Lord Clinton. Mr. Acland suggested that the Standing Committee might be instructed to prepare terms of reference and prepare personnel for the Committee. A resolution was accordingly carried that the Standing Committee should so act.

Unemployment Grants for Land Reclamation 1924-25.—

Mr. W. Hawk (Cornwall) proposed the following resolution—

"That the Ministry of Agriculture be approached with the view of obtaining unemployment relief grants for the 1924-25 season towards the cost of approved land reclamation schemes."

It was seconded and agreed.

Unemployment Grants for Land Drainage During the Summer.—Mr. Davis (Durham) proposed the following resolution—

"That the Minister of Agriculture be urged to consider again the question of authorising the continuance of works of land drainage for the alleviation of unemployment during the summer months, and that the necessary financial provisions should be made for the purpose by the Government."

The resolution was seconded and after discussion put to the meeting and lost.

A Report on Seasonal Agricultural Labour.—Lady Mabel Smith (Yorks) moved—

“That the Ministry be asked if they have any information as to the conditions of seasonal labour, especially as regards women and children, and whether such information can be supplied to the Council in the form of a report.”

Mr. Dallas seconded, and Sir Francis Floud, on behalf of the Ministry, said that the Ministry quite recognised the importance and interest of the subject. The Ministry had a certain amount of information, although it was not extensive enough to make into an authoritative report. It would, however, be glad to prepare a report for the next meeting of the Council.

Further Relief of Agricultural Rates.—Mr. R. L. Walker (Yorks) moved—

“That the Government be asked to consider the question of further relief being given to agricultural lands from the burden of local rates.”

Mr. Hamilton (Lancs) seconded the motion, which was agreed after discussion.

Report of Agricultural Advisory Committee.—Sir Douglas Newton moved that the Report from the Agricultural Advisory Committee of England and Wales on their proceedings be received by the Council. The Report was received and is printed below.

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AGRICULTURAL ADVISORY COMMITTEE FOR ENGLAND AND WALES.

THE following is the half-yearly report (No. 7) to the Councils of Agriculture for England and Wales, on the proceedings of the Agricultural Advisory Committee:—

In response to a request which has been put to us by the Standing Committee of the Council of Agriculture for England on behalf of the Council, we propose in future to make four reports to the Councils in the year instead of two as heretofore. Each report will, as a rule, be made up to such a period before the date of the meeting of the Council of Agriculture for England as will allow of members of the Standing Committee receiving it for consideration a month before the Council meeting.

Between the 30th November, 1923, the date of the last report, and the date of the present report, the Committee has met five times, namely, on the 12th and 31st December, 1923, and 1st February,

6th March, and 2nd April, of the current year. The following subjects were under consideration in the course of these meetings:—

(1) **Foot-and-Mouth Disease.**—This subject has unfortunately been a constantly recurring one on the agenda of the Committee during the period covered. At each meeting the Committee has been informed by the chief veterinary officer of the Ministry of the general position in regard to the disease, and of details of any aspect of it which the Committee wished to discuss. At the meeting of the 12th December the serious situation in Cheshire was carefully considered. The Committee was informed that the large number of outbreaks occurring in this district was due to the fact that it was densely stocked with cattle, and that the dearth of slaughtermen made it impossible for the preventive measures to keep pace with the disease. At this meeting, the Minister reported that the Cabinet Committee had agreed to the continuance of the present policy of slaughter and compensation up to a net cost of 1½ million pounds, when the question would again be considered by the Committee. The subject of further scientific investigations in connection with the disease was discussed, and it was agreed that the Minister (Sir Robert Sanders) should consult Sir Walter Fletcher, Secretary of the British Medical Research Council, on the subject.

The meeting on the 31st December was a special meeting confined to the consideration of matters arising out of the foot-and-mouth disease outbreak, the main question at issue being the continuance of the slaughter policy, especially in relation to the Cheshire area. It was stated that the Cabinet Committee had authorised the Ministry to continue payments in respect of slaughter and compensation until the matter was again considered. The Ministry's chief veterinary officer reported that the disease was now being overtaken in Cheshire, and that, with reference to the resolution passed at the last meeting of the Council of Agriculture (13th December) that the slaughter policy ought to proceed until the Ministry's veterinary authorities advised that a change should be made, he was not at present prepared to advise a change. It was reported that Sir Francis Floud, Permanent Secretary, and Sir Stewart Stockman, Chief Veterinary Officer, had attended meetings in the Cheshire district, and explained that isolation as an alternative to slaughter would involve very drastic regulations if it were to be effective. It would mean that a farm would have to remain under severe restrictions, which would certainly preclude the restocking of it for six weeks to two months after disinfection, and, under such a system in Cheshire, it might be a year before the disease could be eradicated from the county. The question of holding up the store cattle trade was also considered in view of the danger of store cattle spreading the disease in their passage through the country. It was not decided, however, to recommend that the store cattle trade should then be held up.

At the next meeting of the Committee, 1st February, 1924, after a statement by the chief veterinary officer had been made, a resolution was agreed to "that the Agricultural Advisory Committee, having examined the present position, are satisfied with the arrangements made in checking the spread of foot-and-mouth disease."

It was also agreed by the Committee that it be recommended that all local authorities' Orders affecting movement of animals should be

submitted to the Ministry for approval before they became operative. The appointment of a small committee to examine the administrative questions arising out of the present outbreak of disease was also agreed. The question of the importation of Canadian cows and heifers to restock depleted Cheshire farms was examined and the Ministry's action in replying that it was not a matter on which they could authorise importation approved.

At the meeting on 6th March, the chief veterinary officer reported the setback due to infection arising from the markets of Northampton, Nottingham and Lancaster. The question of a general Standstill Order on all cattle, sheep and pigs, including those for slaughter, for three weeks, was considered and thought to be likely to be ineffective owing to insufficiency of the period of standstill, even if it were practically possible. The question of the thorough disinfection of railway trucks was also discussed.

At the following meeting on the 2nd April, the chief veterinary officer was able to report to the Committee that the outbreak was, on the whole, definitely on the down-grade. There was still some danger due to the distribution of manure from slaughterhouses. In regard to disinfection of railway depôts, sidings, loading docks, etc., inspectors had recently been appointed whose exclusive duty would be to examine into actual methods adopted by railway companies, and to report to the Ministry. A new Order had been published defining the manner in which the proper disinfection of railway trucks should be carried out.

(2) Meeting with the Prime Minister.—(On the 1st February, the Committee was summoned to a special meeting with the Prime Minister at Downing Street. The Prime Minister was accompanied by the Rt. Hon. Noel Buxton, M.P., Minister of Agriculture, and Mr. Walter R. Smith, M.P., Parliamentary Secretary. In the course of his remarks, the Prime Minister said that he had invited them to see him in order to assure them that the Government was exceedingly anxious to tackle the agricultural problem and that it regarded the condition of the industry as a national concern. While the Government had to rule out any hope of protection or subsidies of the kind suggested hitherto, it was most earnest in its desire to be of every possible assistance in other directions, and a special committee of the Cabinet had been appointed to examine the problem. The Government would welcome any advice and guidance from practical men who knew the difficulties and who would make suggestions for basing agriculture on a sound, scientific and business-like footing. The Prime Minister said that he felt that the great contribution that the Labour Government could make to the solution of the question was that they will relate the problem of the country to the problem of the town, and that if the agricultural problem was treated as merely a farmers' or a farm labourers' one no solution at all would be arrived at. Short speeches in reply were made by Mr. R. R. Robbins, Mr. Geo. Edwards, M.P., Lord Ailwyn, Sir Douglas Newton, M.P., Lord Clinton, Mr. McLaren, and Mr. McCaig, all of whom expressed the appreciation of the Committee at the invitation to meet the Prime Minister and their desire to assist the Government in regard to any measures which could be taken for the benefit of Agriculture.

(3) **Summer Time.**—The resolution of the Council of Agriculture that summer time should be confined to four months only, commencing the beginning of May and finishing at the end of August, with the qualification that if a longer period was considered desirable in the national interest, it should be continued up to the end of October to cover the potato-lifting season, was considered by the meeting on 1st February. The statements made by the members of the Committee were noted by the Minister.

(4) **Allocation of Fund of £850,000 for Agricultural Education and Research.**—At the meeting of the 1st February, information was circulated dealing with the position in regard to agricultural research as it had been aided from this fund. It appeared the subject had been well provided for, and that a good margin existed for development of further research where needed, and also that educational schemes, including farm institutes, which required money could also be developed. The question of assistance to the Rowett Institute at Aberdeen was raised, and it was pointed out that the matter was one for the Scottish Board of Agriculture to deal with out of the grant of £150,000 made to Scotland. It was also agreed that the Reaseheath, Cheshire, farm institute scheme should be approved, the expenditure on the buildings having been cut down by about £4,000.

The question of a grant to the Monmouthshire farm institute was considered at the meeting on the 6th March and agreed.

(5) **Co-operation and Credit in Agriculture.**—The Committee considered at their meeting on 6th March, memoranda which had been circulated dealing with credit and co-operation in agriculture, and also Leaflet 311 on the formation of agricultural credit societies. In regard to these societies, the Committee was informed that it was to meet the difficulty of uncalled liability possibly preventing non-borrowers from taking up shares in a society, that it had been suggested that the best method of forming the societies would be through existing co-operative societies. These latter would take up shares and would to a large extent control the business; that is to say, loans advanced to members would be expended through the trading society, and they would have the whole matter under their own control. Borrowing members would only be required to subscribe the minimum amount to qualify for loans, *i.e.*, one-tenth, the balance being subscribed by the co-operative society as a non-borrower. That applied both to co-operative societies and to other organised bodies, for instance, a local branch of the National Farmers' Union. The administration and funds of the credit society and the co-operative society would be absolutely separate, although they might have the same executive committee. The object of this was that the funds of the credit section of the society should not be jeopardised by injudicious business on the trading side. Certain difficulties which appeared to stand in the way of success of the credit movement were discussed, and the Minister informed the Committee that he proposed to appoint a standing advisory committee, which would assist with the whole question of co-operation and credit and would naturally go into these questions along with others arising.

(6) **Resignation of National Farmers' Union Members.**—This matter was referred to at the meeting on the 2nd April, when it was agreed that it might usefully be considered at the next meeting of the

Council of Agriculture in connection with any proposals to re-model the constitution of the Council, which would, however, involve legislation to give effect to it. In the meantime, it was understood that the various responsible authorities would be invited to fill the vacancies.

(7) **Draft Bill providing for the Importation of Pedigree Stock.**—The Committee at their meeting on 2nd April considered a draft Bill which had been drawn up on the lines of the agreement made at the Imperial Economic Conference to allow the Minister to admit pedigree stock from a Dominion when satisfied that that Dominion was ready to take British pedigree animals on reciprocal terms, provided also that he had previously approved the herd or flock book in which the pedigree animals of the Dominion were registered.

(8) **Resolutions from Standing Committee of the Council.**—Two resolutions of the Standing Committee (1) suggesting that it should be permitted to see the agenda of the Advisory Committee, (2) that the Advisory Committee should make four reports per annum to the Council instead of two as heretofore, were considered and agreed to.

(9) **Reports from other Committees.**—A report for the three months ended 11th February, 1924, was presented at the meeting on the 6th March. It covered notes on the proceedings of the Basic Slag Committee, Committee on Agricultural Economics, Electro-Culture Committee, Animal Pathology Research Committee, Agricultural Research Council, Conference of Advisory Officers, Central Scholarships Committee, the Livestock Advisory Committee, and other Committees.

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CERTIFICATION OF POTATOES.

THE various Orders which have been issued by the Ministry during recent years under the Destructive Insects and Pests Acts for the control of plant diseases and insect pests have been based on what may be called a "clean seed" policy, *i.e.*, a policy by means of which purchasers of nursery stock, bulbs, etc., may be given some assurance that the goods purchased are free, at least from the more serious diseases to which they are liable. Thus, imported plants, bulbs, etc., are required to be accompanied by a certificate that they are healthy and free from certain specified diseases, and the sale in this country of plants substantially attacked by specified insects and diseases is prohibited.

Last year it was decided to extend the "clean seed" policy to the control of Wart Disease of Potatoes, and this was effected by embodying in the Wart Disease of Potatoes Order, 1923, a requirement that all potatoes planted (except "own saved" seed) and all potatoes sold for planting must be the subject of an Official Certificate. The requirements of the Order and an explanation of the system of certification were set out in an

article published in the issue of this *Journal* for July, 1923 (p. 363).

The certificates specified by the Order as regards potatoes grown in England and Wales are of three kinds :—

(a) A certificate to the effect that the potatoes were grown on land believed by the Ministry to be free from Wart Disease ;

(b) That the crop has been inspected and that on such inspection Wart Disease was not found to exist ; or

(c) That the potatoes were inspected while growing and found to be of an approved immune variety true to type and reasonably free from rogues.

Although the Order did not come into operation until 1st June, 1923, it is satisfactory to record that a large number of applications for these certificates was received by the Ministry. The procedure adopted was to issue certificates under (a) if an examination of the records in the Ministry's possession showed that no case of Wart Disease had been found in the immediate neighbourhood. Certificates of this category were issued in respect of 58,115 acres. In the case of potatoes grown on land less than 1 mile from a field where Wart Disease has been known to exist, or of potatoes grown in an infected area or in a district on the borders of an infected area, no certificates were issued unless the potatoes were actually examined and found to be free from disease. Where the results of these examinations were satisfactory a certificate under (b) was issued. Altogether certificates in this category were issued in respect of 2,900 acres.

The system of insisting on the examination of potato crops grown on the borders of the Wart Disease Infected Area was fully justified by its results. For administrative purposes a district of about 25 to 30 miles in breadth round the borders of the main infected area was treated as a "suspect zone," and no certificates were issued without examination in respect of crops grown in that zone. It was found that in the north-eastern district of Worcester, the disease was more widely prevalent in field crops than had hitherto been suspected, no fewer than 12 fresh cases having been discovered in field crops as a result of inspections in that district. In view of this discovery it has been decided to certify a large portion of Worcestershire as a Wart Disease Infected Area.

The system of crop inspection necessary in order that certificates under category (c) may be granted has been in force since 1918. Its institution in that year was due to the necessity of securing an adequate supply of pure stocks of immune varieties

for planting in Wart Disease Infected Areas, in which at that time only immune varieties were allowed to be planted. These restrictions were modified as from the planting season of 1922 by allowing susceptible varieties to be planted in Infected Areas on land where Wart Disease had not been known to exist. This modification, together with the slump which followed the heavy crop of 1922, led to a reduction in the acreage of immune varieties inspected for purity certificates only, and the acreage inspected fell from 6,200 acres in 1921 to 2,300 acres in 1923.

One of the main features in producing a heavy and uniform crop of potatoes is the use of well selected seed, true to type and free from disease. Seed from diseased crops seldom produces satisfactory results, and crops produced from mixed seed ripen unevenly and in many cases prove disappointing. The Ministry has endeavoured by the introduction of the system of certification to secure occupiers of clean land against planting seed which has been grown in soil infected with Wart Disease, and it will be seen from the foregoing that provision has also been made to enable the farmer to obtain seed of immune varieties which is true to type.

Most potato growers realise the importance of planting true stocks of potatoes, and in order to assist growers to meet the demand for such stocks, the Ministry has arranged not only to continue the inspection of growing crops of immune varieties but also to extend the scheme to growing crops of susceptible varieties.

Growers of potatoes, who intend to sell their crops for seed purposes and who desire to avail themselves of the facilities offered by the Ministry for the certification of their growing crops, are requested to make application not later than 21st July. Forms of application may be obtained from the Ministry's offices and should be carefully filled in and forwarded together with a remittance at the rate of 2s. 6d. for every acre or part of an acre to be examined.

Growers who intend to sell their crop for seed, but who do not desire to obtain a purity certificate should not forget that they must apply to the Ministry for a clean land certificate.

It must be remembered that certificates issued under the Wart Disease of Potatoes Order are of two kinds only; they either certify the purity of the crop from rogues or that no Wart Disease is present on the land in which the potatoes were grown. They must not be taken to mean that the seed to which they relate is free from any disease other than Wart Disease. It

should be noted also that any certificates which may be issued by the Ministry as to the purity of crops of susceptible varieties will be of no value for the purposes of the Wart Disease of Potatoes Order. It will be necessary to obtain "clean land" certificates before the crops are sold for planting.

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JULY ON THE FARM.

J. R. BOND, M.B.E., M.Sc., N.D.A. (Hons.),

Agricultural Organiser for Derbyshire.

Weather Notes.—On the average of long series of seasons, July has the highest mean temperature—about 60° F. in the Midlands—though the hottest day of the year may occur in August or even September. Over the greater part of England the normal night temperature in July does not go below about 53° F., while the normal maximum day temperature is about 70° F. In July the days begin to shorten and normally the duration of bright sunshine is about 20 minutes less per day than in June. In the matter of rainfall, this month is very erratic; on the eastern side of the country it normally measures about 2 in., while in the northern and western districts it averages between 2.5 and 3.5 in. In successive years, however, the precipitation in July may present great contrasts, and, unfortunately, the character of the weather of the preceding months affords no guide as to what rainfall may be expected in this period. The following extracts from records kept by Messrs. Davis & Son show the variations observed at Derby in the last four years:—

				1920	1921	1922	1923	Av. of 1900 to 1920
				in.	in.	in.	in.	in.
May ...	...	...		2.85	1.90	0.94	2.63	2.12
June...	...	..		2.66	0.42	0.74	0.68	2.13
July ...	...	...		5.23	0.59	3.96	4.37	2.68
August	...	...		0.97	5.15	5.15	2.61	2.89

Being the principal hay harvesting month in the grass counties, July pleases best when it brings a period of settled, dry weather. The same conditions favour the arable farmer who has an area of bare fallow, the successful cleaning of which largely depends upon the occurrence of hot rainless weather to dry the clods through and kill the weeds they contain. An unduly prolonged dry period during the time when corn is feeding and maturing the grain, however, is undesirable, and

soil moisture is necessary to allow of the translocation of food materials from the leaves and stem to the apex of the plant: corn does not yield well after premature ripening; but this defect is associated with light rather than medium land. It may be supposed that the heavy rains of May and early June have furnished the soil with all the moisture necessary to complete the growth of corn crops; already there appears to be a tendency towards excess of straw, which much further moisture would cause to lodge; hay crops are very luxuriant and, while roots have come up well, the continuous saturation of the soil during the first half of the season has greatly reduced the cleaning effect of hoeing operations. Undoubtedly a dry July is what most farmers ardently wish for this year.

St. Swithin's.—The common adage is to the effect that as it rains or is fair on 15th July there will be a continuous track of wet or dry weather for the forty days ensuing. St. Swithin, who was Bishop of Winchester, died about A.D. 862, and in accordance with his request he was buried in the churchyard. On 15th July, 971, however, his remains were translated to the interior of the cathedral. It is said, but on doubtful authority, that the popular belief associated with the anniversary of the translation arose from the occurrence of a wet period of forty days which commenced on that day. It may be of interest to add that rainfall records lend no support to the popular adage, although the date is very near a well-known bad time in wet years.

Arable Land.—Corn crops usually pass through the milky and the waxy stages of ripening in the month of July, giving the final warning to see that the self-binders are in good order. Winter oats and winter barley often reach technical ripeness—the “ready-to-cut” stage—in this month, but it is only in early districts or exceptional seasons that the harvesting of wheat and spring corn becomes general before August. In many districts, especially near centres of population, sparrows are a serious pest to the corn grower at this time of the year. Some years ago sparrow clubs did good work for a time, but in most cases they ceased to exist when their continuance might have led to a real reduction in the numbers of this very noxious bird. One farmer in Midlothian continued to attend to his sparrow-trap after the local club had become defunct, and showed the writer records of his annual catch, numbering about 400 sparrows each year.

On the bare fallows July is the time for stirring and reducing the clods: earlier refinement of the land usually defeats the object by keeping the soil too moist for the weeds to be killed. Where lime is applied at this stage in the rotation, the horses and labour may best be spared for that work between hay and corn harvests. Pen-fallowing (*i.e.*, breaking up second-year seed layers soon after the removal of the hay crop) is regarded with much favour in certain districts where wheat follows "seeds." By ploughing, immediately after the hay crop has been taken, or after the flush of grass has been consumed in cases where the crop is grazed, time is allowed for a fairly thorough stirring and cleaning of the land before the wheat is sown. Last year the writer noted considerable benefit from the cultivation of a catch crop of mustard grown before the land was sown with wheat.

Work among root crops is now almost limited to shallow horse-hoeing and the filling of gaps, although in some districts the season for root-sowing extends far into July. Where the crops have begun to extend their foliage across the interspaces between the drill rows, care should be exercised in the work of horse-hoeing. The main reason for caution at this stage is not so much to avoid damage to the tops of the crop as to avoid driving the shares of the hoe through the root fibres, from the ends of which the plant feeds. Considerable damage is every year accountable to neglect of this precaution, and there is a certain amount of evidence that the ravages of finger-and-toe disease among swedes and turnips are accentuated by injudicious use of the horse-hoe at this stage. On heavy or wet land, root crops may be lightly earthed up with the double mould-boards after the last stirring: the object of this is to hold the land drier for the harvesting of the crop in November.

Ensilage.—Although haymaking is the principal work in July, farmers who have erected silos will generally complete the filling during the periods when weather considerations prevent progress in the hay fields. During the past few years ensilage has gained considerable favour among arable farmers, and the tower silo is becoming a familiar feature of farm steadings. Tower silos are being made of various materials and perhaps it may be of interest to mention that in the neighbourhood of Worcester there may be seen three silos which were at one time the funnels of an Atlantic liner; these have been in use for a number of years and give good results.

During the 'eighties of last century, when there was a succession of wet summers, considerable attention was paid to the possibility of substituting ensilage for haymaking as a means of securing the produce of meadow land. Favourable reports were published by both of the two principal agricultural societies, and for a time the ensilage of fodder in stacks and rectangular silos was widely practised. With the return of better weather conditions, however, interest in the process subsided, and in the 'nineties ensilage had ceased to be considered as a practical alternative to haymaking in reasonably good weather. The principal objections to the ensilage of grass crops by the methods then tried were the wastage involved, the uncertainty of the product, its smell, and its small market value compared with that of hay.

Modern ensilage practice is concerned less with the hay crop than with the substitution of a part of the root break with a forage crop, generally winter oats and vetches. Naturally it is most attractive to the occupiers of considerable areas of arable land and especially to those who encounter difficulties in dealing with the root break. Ensilage assists in distributing the labour requirement of the farm uniformly over the whole season, which is one of the first principles of economical farm management.

It had been stated by one who has examined the silage made on many farms that bad silage is rarely made in a tower silo. The product does vary, however, according to the temperature attained by the mass during its fermentation. A certain amount of heating in the silo is desirable—to 100° F. or even 120° F.—to ensure which it is essential that the fodder be ensiled alive and not too wet.

Consequent upon the demonstration of the success of the tower silo, interest has revived in other ways of making silage. Mr. A. W. Oldershaw, Agricultural Organiser for East Suffolk, has called attention to the trench method practised for upwards of thirty years by Mr. Wm. Makens, of Colney, Norwich. A trench is opened (in suitably dry ground) about 13 ft. wide, 4 ft. deep, and in length 3 to 4 ft. for each acre of crop to be ensiled. Into this trench the green fodder in its long state is tipped and consolidated, the empty carts being drawn over the mass. The heap is built up to a height of several feet above ground level and a good steep roof is made, steep enough to shed rain after the mass has settled. The ends and sides are trimmed, a topping-up of hedge-side material is put on and the whole

is covered with an 8-in. coat of earth. After the mass has settled, the resulting cracks in the soil-coat are filled in to prevent the entry of air and water.

Pastures.—At the time of writing many pasture fields are running to seed, and generally they carry an excess of growth which in the ordinary course of grazing will not be well utilised. It is a rule of good husbandry that the coarse ungrazed portions of pastures (as well as any thistles) should be mown in July, but it is not always possible to collect and make use of the mowings. A few farmers have recently adopted the Dutch plan of ensiling as much of the produce of the pastures as the cattle appear not to require in the summer. During July and August there are usually many wet days when it is difficult to find productive employment for the men between milking times; at such times the pastures can have the attention here suggested. In the cases where the practice has come to the writer's notice, the pasture mowings have been made into stack silage, the forage being put on from time to time when opportune. The trench method, however, appears most to commend itself for those who have not occasion to build cylindrical pit or tower silos but who desire to avoid the wastage that is almost inevitably associated with the stack method.

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MONTHLY NOTES ON FEEDING STUFFS.

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Mineral Mixtures for Pig Feeding.—It has been demonstrated, both in America and in this country, that the addition of mineral substances to the ration normally fed to pigs is sound practice, particularly when the foods used are all of vegetable origin. It has also been proved at the Rowett Research Institute that a serious condition of mal-nutrition can arise in pigs in the absence of iron in the dietary, and that this condition is quickly alleviated by the addition of small quantities of a simple iron salt. Notes have appeared in this *Journal* from time to time showing that the inclusion of mineral mixtures in pig dietaries is a sound and economical practice. In America much work of a practical character has been carried out on this aspect of nutrition, and a recent bulletin issued from Iowa Agricultural Experiment Station summarises the results of the work of

DESCRIPTION.	Price per Qr.		Price per		Manurial Value per Ton.	Cost of Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv.	Price per lb. Starch Equiv.
			Cwt.	Ton.					
	s. d.	lb.	s. d.	£ s.	£ s.	£ s.	s.	s.	d.
Wheat, British -	—	—	12/-	12 0	0 16	11 4	71.6	3/2	1.70
Barley, Karachi -	34/6	400	9/8	9 13	0 12	9 1	71	2/7	1.38
" Persian -	31/6	"	8/10	8 17	0 12	8 5	71	2/4	1.25
" Tunisian -	32/3	"	9/-	9 0†	0 12	8 8	71	2/4	1.25
Oats, English, White -	—	—	10/4	10 7	0 14	9 13	59.5	3/3	1.74
" " Black and Grey -	—	—	10/-	10 0	0 14	9 6	59.5	3/2	1.70
" Canadian :—									
No. 2 Western	27/-	320	9/5	9 8	0 14	8 14	59.5	2/11	1.56
No. 3 " "	26/-	"	9/1	9 2	0 14	8 8	59.5	2/10	1.52
Feed " "	24/9	"	8/8	8 13	0 14	7 19	59.5	2/8	1.43
" Argentine -	23/3	"	8/2	8 3	0 14	7 9	59.5	2/6	1.34
" Chilean -	27/3	"	9/6	9 10	0 14	8 16	59.5	2/11	1.56
Maize, American -	41/6	480	9/8	9 13†	0 13	9 0	81	2/3	1.20
" Argentine -	43/6	"	10/2	10 3	0 13	9 10	81	2/4	1.25
" Galatz-Foxanian -	43/3	"	10/2	10 3†	0 13	9 10	81	2/4	1.25
" Karachi -	43/-	"	10/-	10 0	0 13	9 7	81	2/4	1.25
Beans, English Winter -	—	—	11/-	11 0	1 13	9 7	67	2/9	1.47
" Rangoon -	—	—	10/1	10 2†	1 13	8 9	67	2/6	1.34
Peas, Japanese -	—	—	22/6	22 10†	1 9	4 1	69	6/1	3.26
Millers' Offals :—									
Bran, British -	—	—	—	6 15	1 7	5 8	45	2/5	1.29
" Broad -	—	—	—	8 0	1 7	6 13	45	2/11	1.56
Middlings—									
Fine, Imported	—	—	—	9 7	1 3	8 4	72	2/3	1.20
Coarse, British	—	—	—	8 12	1 3	7 9	64	2/4	1.25
Pollards, Imported -	—	—	—	7 0†	1 7	5 13	60	1/11	1.03
Meal, Barley -	—	—	—	10 10	0 12	9 18	71	2/9	1.47
" Maize -	—	—	—	11 10	0 13	10 17	81	2/8	1.43
" " Germ -	—	—	—	9 2	0 19	8 3	85.3	1/11	1.03
" " Gluten Feed -	—	—	—	9 7	1 8	7 19	75.6	2/1	1.12
" Locust Bean -	—	—	—	8 5	0 10	7 15	71.4	2/2	1.16
" Bean -	—	—	—	13 0	1 13	11 7	67	3/5	1.83
" Fish -	—	—	—	19 0	4 8	14 12	53	5/6	2.95
Linseed -	—	—	—	19 15	1 12	18 3	119	3/1	1.65
" Cake, English	—	—	—	—	—	—	—	—	—
12% Oil	—	—	—	12 2	1 19	10 3	74	2/9	1.47
" 10% Oil	—	—	—	11 7	1 19	9 8	74	2/6	1.34
" 9% Oil	—	—	—	11 5	1 19	9 6	74	2/6	1.34
Cottonseed Cake, English	—	—	—	—	—	—	—	—	—
" 5½% Oil	—	—	—	8 0	1 16	6 4	42	2/11	1.56
" " Egyptian	—	—	—	—	—	—	—	—	—
5½% Oil	—	—	—	7 15	1 16	5 19	42	2/10	1.52
Decorticated Cotton	—	—	—	—	—	—	—	—	—
Seed Meal 7% Oil -	—	—	—	12 0†	2 16	9 4	71	2/7	1.38
Coconut Cake 6% Oil -	—	—	—	9 12	1 11	8 1	73	2/2	1.16
Palm Kernel Cake 6% Oil -	—	—	—	7 2†	1 5	5 17	71.3	1/8	0.89
Feeding Treacle -	—	—	—	7 7	0 8	6 19	51	2/9	1.47
Brewers' Grains :—									
Dried Ale -	—	—	—	6 10	1 5	5 5	49	2/2	1.16
" Porter -	—	—	—	6 2	1 5	4 17	49	2/-	1.07
Wet Ale -	—	—	—	1 3	0 9	0 14	15	-/11	0.50
" Porter -	—	—	—	0 17	0 9	0 8	15	-/6	0.27
Malt Culms -	—	—	—	8 0†	1 15	6 5	43	2/11	1.5

† At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of May and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose coconut cake is offered locally at £10 per ton. Its manurial value is £1 11s. per ton. The food value per ton is therefore £8 9s. per ton. Dividing this figure by 73, the starch equivalent of coconut cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22.4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1.26d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 13s. 6d.; P₂O₅, 4s. 1d.; K₂O, 2s. 6d.

Professor Evvard and his co-workers on this subject. These workers have shown that a simple mixture of wood ashes and salt gives good results in practice. Wood ashes are deficient in sodium, chlorine, phosphorus and iodine, and a wood ash mixture should therefore contain common salt, potassium iodide, and steamed bone flour or bone phosphate to supply these deficiencies. It has also been shown that the addition of charcoal, sulphur, calcium and iron is sometimes desirable. The following three mixtures have been shown to give good results in practice, No. 2 being of a laxative character :—

(1)	Hard wood ashes	...	52 lb.	Common salt	...	...	15 lb.
	Bone charcoal	...	25 "	Potassium iodide	...	...	.02 "
(2)	Hard wood ashes	...	52 "	Glauber's salts	...	...	4 "
	Bone charcoal	...	25 "	Epsom salts	...	...	2 "
	Common salt	...	12 "	Copperas	...	...	2 "
	Flours of sulphur	...	3 "	Potassium iodide	...	...	.02 "
(3)	Common salt	...	20 "	Bone charcoal	...	...	40 "
	Finely ground limestone or chalk	...	40 "	Potassium iodide	...	...	.05 "

The main points emphasised in American practice are as follows :—

(1) Common salt is of major importance in building up a good mineral mixture: salt is essential for *all classes* of stock.

(2) There is no mineral mixture which can be regarded as the best for all conditions of feeding. Many good mineral mixtures can be compounded, but it is wise to bear in mind in compounding a mineral mixture that the following elements should be included:—Sodium and chlorine—as in common salt; calcium—as in high-grade limestone or chalk; wood ashes: phosphorus—as in bone products; and iodine—as in potassium iodide.

* * * * *

FARM VALUES.

CROPS.	Market Value per lb. S.E.	Value per unit S.E.	Starch Equivalent per 100 lb.	Food Value per Ton.	Manurial Value per Ton.	Value per Ton on Farm.
	d.	s. d.		£ s.	£ s.	£ s.
Wheat - - - - -	1·20	2 3	71·6	8 1	0 16	8 17
Oats - - - - -	1·20	2 3	59·5	6 14	0 14	7 8
Barley - - - - -	1·20	2 3	71·0	8 0	0 12	8 12
Potatoes - - - - -	1·20	2 3	18·0	2 1	0 4	2 5
Swedes - - - - -	1·20	2 3	7·0	0 16	0 2	0 18
Mangolds - - - - -	1·20	2 3	6·0	0 14	0 3	0 17
Good Meadow Hay - -	1·16	2 2	31·0	3 7	0 14	4 1
Good Oat Straw - - -	1·16	2 2	17·0	1 17	0 7	2 4
Good Clover Hay - - -	1·16	2 2	32·0	3 9	1 1	4 10
Vetch and Oat Silage -	1·16	2 2	14·0	1 10	0 7	1 17

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	Average Price per ton during week ending June 18th.				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 5	..	13.12	14. 0	18. 1
" " Lime (N. 13 per cent.) ... ..	..	12.10	..	12.10	19. 3
Sulphate of Ammonia, ordinary (N. 20¾ per cent.)	14. 2*	14. 2*	14. 2*	14. 2*	(N)13. 7
" " " neutral (N. 21¼ per cent.)	15. 5*	15. 5*	15. 5*	15. 5*	(N)14. 5
Kainit (Pot. 12½ per cent.) ... ..	..	..	..	2. 5	3. 7
French Kainit (Pot. 14 per cent.)	2.10	2. 6	2. 5	2.12	3. 9
" " (Pot. 20 per cent.) ... ..	..	2.10	..	2.17	2.10
Potash Salts (Pot. 30 per cent.) ... ..	..	..	..	3.15	2. 6
" " (Pot. 20 per cent.) ... ..	..	..	2.10	2.15	2. 9
Muriate of Potash (Pot. 50 per cent.)	8. 5	7. 5	7.10	7.10	3. 0
Sulphate of Potash (Pot. 48 per cent.) ... ..	..	11. 5	11.10	11.10	4. 9
Basic Slag (T.P. 30 per cent.) ... ..	..	..	2.12§	..	..
" " (T.P. 28 per cent.) ... ..	..	2. 1†	..	..	..
" " (T.P. 26 per cent.) ... ..	..	1.14†	..	..	..
" " (T.P. 24 per cent.) ... ..	..	1.11†	2. 0§	..	..
Superphosphate (S.P. 35 per cent.)	4. 4	..	3.15§	3.10	2. 0
" " (S.P. 30 per cent.)	3.16	3. 7	3. 8§	3. 2	2. 1
Bone Meal (N. 3¾, T.P. 45 per cent.)	9. 0	8.15	8.10	7.15	..
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	6.17†	6.15†	6. 0	6. 2†	..
Fish Guano (N. 7½-8½, T.P. 16-20 per cent.)	12.15	..	13. 0	..	..
" " (N. 9, T.P. 10 per cent.) ... ..	..	..	..	13.10	..

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named.

THE second World's Poultry Congress took place at Barcelona and Madrid from 9th-19th May, twenty-five countries being represented. The proceedings were attended by over 60 representatives from this country. Most of the British representatives left Victoria Station on the morning of 7th May and were accompanied by a number of American and Canadian representatives.

The Congress was formally opened in the Grand Hall of the University of Barcelona, on 10th May, by His Excellency the

Sub-Secretary of Agriculture, in the presence of State Officials (Civil, Military and Naval), the Mayor and Corporation of Barcelona, the Consular Corps, the official delegates to the Congress from all the countries concerned, and a large company of visitors. In responding to the official address of welcome by the Secretary-General of the Congress, Mr. Edward Brown (Joint President of the Congress with Professor Salvador Castello) called attention to the fact that several of the most valuable breeds of poultry had originated in Spain. It was Spain also that had introduced the turkey to Europe. Although Spain had for a long period given attention to poultry breeding, other European countries had perhaps made more rapid advances during the last half-century, owing no doubt to the impulse of industrial and commercial developments, and to vast increases in the human population. They who were from those other European countries had come to repay something of their indebtedness to Spain, to lay before her their experience and to learn what she had to teach.

It was the object of these international poultry congresses to gather into one focus all the best of the knowledge and experience that had been gained by the workers in the industry in all countries, so that it might be disseminated for the benefit of all, instead of being more or less buried; and to find out how far each country's problems had been met with or solved in other countries.

Mr. Brown also pointed out that the universality of poultry breeding and production was one of its most striking characteristics. In relation to food supplies, poultry had been for centuries merely a side issue, primarily to meet household needs. Under such circumstances little attention would be given to the breeding qualities and productive capacity of the stock, to true economy in housing and feeding, to marketing produce on the best lines and to the prevention of disease. A fundamental change had, however, taken place within recent years, most of all in Western Europe, North America, Australia and New Zealand, where commercial egg and table poultry production had shown itself to be an economic success.

An impressive speech made at the first meeting of the Congress by Prof. Don Salvador Castello, who was the Spanish organiser of the Congress and Exhibition, concluded as follows:—

“I must thank the press for the assistance rendered to the Executive Committee and to me personally during

the past thirty years, during which I have employed all my activities in speaking in capital cities, towns and insignificant villages of the advantages of poultry breeding as an inexhaustible fountain of rural riches. The hour has arrived to say to all Spain: See what I have preached; see here assembled the great World's Exhibition of Aviculture, the crystallisation of what is done in the most advanced countries. The lands beckon us to follow their example, and if we do so we shall make such progress in Spanish poultry production as not only to maintain but improve the creditable position which we have already achieved in this World's Second Congress and Exhibition."

The following Resolution, which was adopted by the Congress, directed attention to the establishment of a National Poultry Institute in England:—

"That it is desirable that Aviculture Research Institutes, similar to that described in the paper contributed by Mr. H. E. Dale, of the English Ministry of Agriculture, should be established in all countries."

It is hoped that translations in English of the various papers read at the Congress will be obtainable in due course. Individuals desiring copies of these papers should make application to the Hon. Secretaries, Second World's Poultry Congress Committee, 3, Vincent Square, Westminster, S.W.1.

With regard to the Exhibition, which was opened at Barcelona on Saturday, 10th May, and closed in the evening of Sunday, 18th May, there is no doubt whatever that this was a great success. The exhibits filled a large hall (approximating in size to that of the Main Hall at Olympia), which was beautifully decorated in the true Spanish style. Over 120,000 people visited the Exhibition, which was divided into sections for the grouping of the exhibits received from each of the countries represented. Large sections of the hall were taken by Holland, Italy, France, Canada, the United States, Denmark, Czechoslovakia, Belgium, Spain and Great Britain. It is impossible to give here a detailed description of each country's exhibits. It must suffice to say that each country represented made a good display. The British exhibit comprised some 83 pens of birds (usually three in a pen). All the fowls looked very well after their long journey. The British list of exhibitors was headed by H.R.H. the Prince of Wales, whose White Wyandottes, Rhode Island Reds and Australorps were penned near to the exhibits from the Queens of Spain and Belgium. It was

generally agreed that the British Section, as a whole, stood easily first both in point of numbers and quality, and it was easy to trace English blood in the exhibits of some other countries. The educational and scientific exhibits in the British Section attracted a good deal of interest, especially when it is remembered that these were the outcome of individual effort as compared with the State-supported exhibits of other countries.

Professor Punnett's exhibit of specimens illustrating the principles of sex-linked inheritance in poultry breeding, which were supported by some stuffed specimens (lent by the Ministry) of adult birds and chicks, attracted much interest. The meaning of these exhibits was made clear by letterpress in Spanish as well as English. The Hon. Florence Amherst contributed a display of specimen eggs of most of the breeds of British poultry, which were attractively set out in cases. These were supported by small cardboard models of the breeds which laid the eggs shown. These models were lent by *The Feathered World*. A collection of photographs on poultry subjects and model poultry houses was contributed by Harper Adams Agricultural College.

An interesting exhibit received from Dr. Crew, of Edinburgh University, included some photographs of an abnormal hen during its process of assuming male characteristics. Doctors Plimmer and Rosedale, of St. Thomas's Hospital, London, sent exhibits showing how essential food factors influence the colour of the yolk in an egg, and how the lack of these essential factors influence the resulting chick. A display of illustrations of British breeds of poultry, produced by *The Feathered World* added a welcome touch of colour to the exhibit.

The Congress decided to accept an invitation from Canada to hold the next World's Poultry Congress at Ottawa, Canada, in 1927.

* * * * *

THE Rural Industries Intelligence Bureau has recently issued a leaflet* dealing with Bundled Firewood Manufacture, the

Firewood: A object being to encourage the firewood
Rural Industry. business in rural districts. It is pointed

out that the industry, if properly carried out with up-to-date appliances, "can be quite a reasonably profitable undertaking, not only for the small worker, but also by no means beneath the notice of the estate owner or agent, as a useful means of dealing with otherwise almost valueless small timber, tops and thinnings on his property."

* Leaflet No. 12 (*Bundled Firewood Manufacture*).

“While it can be said with a fair amount of truth that in this business ‘All is grist that comes to the mill,’ there are nevertheless many interesting and several important peculiarities in the combustive properties of different species of woods which render them more or less suitable either for burning simply as fuel, or for splitting up for bundle wood. The requirements for the two cases are not the same, and what is good for the former purpose is not necessarily ideal for the latter. A few remarks therefore on differences of behaviour of some of the better-known varieties will not be out of place here.”

“There is much difference of opinion in regard to the respective merits of various home-grown timbers when used for firewood. The age and quality of wood has, of course, a great deal to do with its capacity for heat production, old slow-grown and thoroughly seasoned timber having much greater lasting and heating value than young and sappy growths with a comparatively small amount of heart wood.”

“Roughly speaking, the heat value of wood is more or less according to its hardness. Those kinds which burn slowly, evenly and quietly, eventually produce the greatest amount of heat, and are consequently most suited to be used as fuel for heating purposes; while the soft woods generally, and those which crackle and emit sparks during combustion, burn rapidly, developing an intense heat of short duration, and are therefore rather wasteful as fuel, except for special purposes. For instance, fuel of this latter kind was formerly used in the pottery and glass trades and for bakers’ ovens. These woods are specially suited for bundle-wood manufacture, although their value for sustained heating effect is generally low.”

“Woods much given to sparking are not as a rule desirable as fuel, though in other respects they may be quite suitable. There are some species of woods indeed which burn with almost explosive violence, throwing out dangerous showers of sparks and glowing fragments, but these are not to be found amongst English varieties. Examples of woods which are, however, liable to sparking are resinous pinewoods, cedar, spruce, silver firs, also, to some extent, hawthorn and ash.”

“For the purposes of the firewood bundler, with whom this pamphlet is mainly concerned, the foregoing peculiarities are not of great importance, and there are very few woods which can be said to be really unfitted for this purpose, though some of course are better than others. The principal requirements

are that the wood shall be easily cut and split and quick burning, and on this account soft woods are preferable to hard. Liability to sparking is no serious disadvantage, as fires are presumably under observation while the kindling is being consumed, and smell and smoke, pleasant or otherwise, are matters of indifference."

"One or two special points may be alluded to. Oak splits easily but is slow burning, and is better not used for bundling unless obtainable in the form of trade waste, such as well-seasoned ship timber, old barrel-staves, etc. Amongst distinctly unsuitable woods may be mentioned privet, lilac, blackthorn, on account of their hardness, and elm on account of its cross grain as well as its slow-burning propensities. Poplar and non-resinous larch, especially when not thoroughly seasoned, are poor combustibles."

After giving examples dealing more fully with various species of woods which may be used for firewood, the leaflet considers storing, drying and seasoning; methods of obtaining supplies; pit props and trade waste; equipment (saws, engines, bundling machines); chopping; prices; costs of production; and several other matters of importance relative to the starting of a firewood business. A copy of the leaflet may be obtained from The Secretary, Rural Industries Intelligence Bureau, 258-262, Westminster Bridge Road, London, S.E.1.

* * * * *

THE Railway Fires Act, 1905, as amended by the Railway Fires Act (1905) Amendment Act, 1923, provides that, when

**Railway
Fires Acts.**

damage is caused to agricultural land or to agricultural crops by fire arising from sparks or cinders emitted from any locomotive engine used on a railway, the fact that the engine was used under statutory powers shall not affect liability in an action for such damage, but this provision does not apply in the case of any action for damage in which the claim for damage in the action exceeds £200.

The expression "agricultural land" includes arable and meadow land and ground used for pastoral purposes or for market or nursery gardens, and plantations, woods and orchards, and also includes any fences on such land, but does not include any moorland or buildings; and the expression, "agricultural crops" includes any crops on agricultural land, whether growing or severed, which are not led or stacked.

Section 2 provides that a railway company may enter on any land and do all things reasonably necessary for the purpose of extinguishing or arresting the spread of any fire caused by sparks or cinders emitted from any locomotive engine.

It also provides that a railway company may, for the purpose of preventing or diminishing the risk of fire in a plantation, wood, or orchard, enter upon any part of the plantation, wood, or orchard, or on any land adjoining thereto, and cut down and clear away any undergrowth, and take any other precautions reasonably necessary for the purpose; but they must not, without the consent of the owner, cut down or injure any trees, bushes or shrubs.

A railway company exercising powers under this section must pay full compensation to any person injuriously affected by the exercise of those powers, including compensation in respect of loss of amenity.

The Act does not apply in the case of any action for damage by fire brought against any railway company unless (1) notice in writing of the fire having occurred and of intention to claim in respect thereof shall have been sent to the said railway company within seven days of the occurrence of the damage; and (2) particulars in writing of the damage showing the amount of the claim in money not exceeding the said sum of two hundred pounds shall have been sent to the said railway company within twenty-one days of the occurrence of the damage.

Light railways and tramways worked by steam power are within the scope of the Act.

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THERE is an unusual number of farmers in Berkshire who are licensed for the production of "Certified" and "Grade A"

**Instruction in
Clean Milk
Production in
Berkshire.**

milk, or who are endeavouring to produce milk of similar standard. This is no doubt due to the location in the county of the National Institute for Research in Dairying. The Berkshire County Agricultural Instruction Committee, with a view to promoting the further adoption of improved methods, recently instituted a series of 10 demonstrations in clean milk production at certain licensed farms in the county, farmers and their herdsmen in the vicinity being invited to attend.

A representative of the National Institute for Research in Dairying and the County Instructress were present to explain

the whole process of Clean Milk Production at these demonstrations, which were conducted on lines advocated by the Ministry. After the visitors had been shown the cowsheds and dairy, the preliminary operation of grooming the cows and washing their udders and flanks was carried out. The milkers then washed their hands and put on the special coats and caps before milking the cows. Covered pails were used, and as each cow was milked the milk was poured into the carrying pails, taken direct to the cooler, strained and run into 10-gallon milk churns. The churns when filled were sealed and the milk placed on a lorry for transport. Directly the operation was completed all utensils were thoroughly cleaned by washing and steaming.

Great interest was shown at each of the demonstrations, the audiences being able to see the actual methods employed at the licensed farms. As many as thirty farmers with their men attended some of the meetings.

It was thought desirable to point out that model buildings of elaborate design are not essential for the production of clean milk, and one demonstration was given, therefore, at the old farm buildings of the National Institute for Research in Dairying. It was shown there that it is the methods employed and not expensive buildings that are essential for the production of clean milk.

As a result of the demonstrations a clean milk competition has recently been held for herdsmen, whose interest, no less than that of the farmers, must be evoked, if success is to be achieved.

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THE Ministry of Agriculture and Fisheries is taking advantage of the presence in England this summer of a number of Dominion botanists and mycologists to hold a conference affording an opportunity for a free and open discussion between members of the British Empire of the scientific principles which should underlie legislation regulating the import of plants and plant products.

**Conference on
Plant Disease
Legislation.**

The Council of the Surveyors' Institution have kindly offered the use of the Lecture Hall at 12, Great George Street, Westminster, and the conference will be held there on Thursday, the 17th July, commencing at 11 a.m.

The presence of scientists, nurserymen and other persons interested in the subject will be welcomed.

In order both to protect purchasers of stocks of bees and to effect an improvement in the health standard of bees, the

**Examination and
Certification of
Apiaries.**

Ministry of Agriculture and Fisheries has made arrangements for the inspection, on application, of apiaries where bees are raised for sale. Where no brood diseases are found to be present in an apiary, an official certificate to that effect will be issued. For the present it will not be possible to include Acarine disease in the scheme, and the certificates will relate solely to freedom from brood diseases, though they will not be issued for apiaries where Acarine disease is seen to be present. The frames containing the combs of the colonies that are passed on inspection will be impressed with a metal stamp with the date of inspection, and this will afford protection to the purchaser. Owners of apiaries where bees are raised for sale are invited to make early application for inspection. All applications should be addressed to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1. Fees at the rate of £2 2s. per day, with a minimum of £1 1s., will be charged for this service.

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THE Commercial Secretary of the British Legation at Bucarest states that an extraordinary credit has been placed at the disposal of the Rumanian Ministry of Agriculture and Domains for the purpose of purchasing bulls, rams and boars for breeding purposes.

**Export of Boars
to Rumania.**

There would appear to be no opening for British bulls and rams, but there is every prospect that the departmental commissions would approve purchases of British boars. Any breeders in this country wishing to sell boars to Rumania should send their offers direct to the Ministry of Agriculture and Domains, Direction Zootechnica, Bucarest.

* * * * *

THE Ministry has approved a proposal of the Durham County Council to award scholarships in poultry-keeping tenable at the County Poultry Station at Houghall, and will aid expenditure thereon under the Education Grant Regulations up to a maximum of £90 in the current financial year. These scholarships will be of 12 weeks' duration, and the number of awards will probably be six annually (value not exceeding 25s. each per week, to cover tuition, board and lodging).

**Poultry-Keeping
Scholarships.**

Scholarship holders will be under the direct control of the poultryman at the Station, and he will be responsible, under the supervision of the County Poultry Instructor, for their practical training. Lectures and theoretical instruction will be given by the Poultry Instructor on three days a week, and as wide a range of subjects as possible will be covered in the 72 lectures which it is proposed to deliver during each course, which will include incubation, rearing, breeding, feeding, housing, diseases and book-keeping.

It is the Authority's intention that practical and theoretical knowledge shall be combined in the course in such a way that the scholarship holders will gain a sound knowledge of the principles underlying successful poultry-keeping.

* * * * *

Foot-and-Mouth Disease.—The position has undergone considerable fluctuations since the June issue of the *Journal*. The outbreaks for the week ended 25th May fell to 8, and during the following week no outbreak occurred in any part of the country. During the week ended 8th June, however, 5 outbreaks were confirmed, of which 1 was in Kent in a free area, 1 in Northants, and 3 in Notts. The Northants and Notts outbreaks necessitated extensions of the respective infected areas in which the cases occurred.

During the week ended 15th June, 10 outbreaks occurred, the counties involved being: Berks (1), Derby (2), Northants (2), Notts (3), Oxford (1), and Yorks E.R. (1). Of these the outbreaks at Iffley, Oxon, on 10th June, and Halsham, Yorks E.R., on 12th June, occurred in new areas, while extensions of areas were necessitated by the outbreaks in Berks and Derby. During the week ended 22nd June, 17 outbreaks occurred including 8 in Surrey, and involving a new district.

The total number of outbreaks from the 27th August, 1923, to 22nd June, 1924, is 3,127, involving 41 counties in England, 2 in Wales, and 12 in Scotland, and the slaughter of 104,760 cattle, 43,856 sheep, 48,485 pigs, and 129 goats. The gross amount payable in compensation for these animals is £3,342,000, and the receipts in respect of the salvage of healthy carcasses amounts to £495,000.

Importation of Plants into Canada by means of the Parcel Post.—The Ministry desires to inform exporters of plants that the Canadian Authorities have withdrawn the prohibition placed on the importation of nursery stock through the mails. Small parcels of plants, bulbs, etc., may now be sent to Canada by the parcel post, each parcel being accompanied by the usual official certificate of health issued in the country of origin. The consignment will also be examined at the port of entry (Vancouver or Montreal).

The Canadian importer must first obtain an import permit in the usual manner, and indicate that he desires to import by means of the parcel post. Special labels will be furnished to the applicant, who should send them to the exporter to be affixed to the packages, together with the copy certificate of health. Exporters are recommended to

place inside the package an additional label indicating the address of the consignee.

Small consignments of plants to be sent to Canada by parcel post can be examined at the Ministry's office, 10, Whitehall Place. A fee of 1s., payable in advance, is charged, and the following procedure must be followed:—The plants must be sent to the office of the Ministry in a box which can easily be opened, and packed in such a way that they can be taken out and thoroughly examined and then repacked by the inspector. The box must be labelled "Plants (bulbs or seeds) for export." The necessary labels, prepaid, and directed to the Canadian address, must be enclosed, *together with the Customs declaration required by the postal regulations.* After examination the parcel will be posted, and a receipt of posting obtained and sent to the consignor. If it be desired that the parcel shall be insured, the requisite sum must be forwarded. Parcels should, where possible, reach the Ministry at least a week before the departure of the mail.

Establishing a Tuberculosis-Free Dairy Herd.—With reference to the fifth paragraph on page 147 of this *Journal* for May, 1924, in the article by S.E.B. dealing with the Establishment of a Tuberculosis-Free Dairy Herd, results of the cod liver oil method of calf rearing have now been obtained.

On 15th May, 1924, 35 calves (average age 9.31 months) were tested. 24 of these calves had been reared on the cod liver oil method, and 11 on the Grade "A" method. All 35 calves satisfactorily passed the test.

Leaflets issued by the Ministry—Since the date of the list given on page 303 of the June issue of the *Journal*, the following leaflets have been issued:—

New—No. 37. Bean Aphis.

Revised—No. 195. American Gooseberry Mildew.

Amended—No. 23. Potato disease (Blight) and its Prevention.

Feeding Trials with Silage.—Regarding the article on "Feeding Trials with Silage," which appeared in the *Journal* for April, 1924, page 50, objection has been made that the results of the experiments tabulated therein are at variance with those obtained in previous trials. It should be explained, therefore, that the author of a signed article in the Ministry's *Journal* is solely responsible for the statements made in it. It will be obvious that in experimental work in any branch of agriculture the results obtained by different investigators and the conclusions drawn by them may differ, but it may nevertheless be desirable to publish the results as matters of interest.

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QUESTIONS IN PARLIAMENT.

Hop Control.—In reply to a question asked in the House of Commons on 30th May by Viscount Wolmer, as to whether it is proposed to extend the hop control beyond the date of its lapse, 16th August, 1925; and whether to do so would require legislation, Mr. Noel Buxton, Minister of Agriculture, replied: "I am giving careful consideration to the organisation of the hop industry in view of the termination of the present period of control in August, 1925, but I am not yet in a position to make any statement on the subject. The reply to the last part is in the affirmative."

Insolvencies among Farmers—Mrs. Philipson asked the Minister of Agriculture in the House of Commons on 26th May, what is the information in detail upon which the statement is made in the current (May) number of the Official Journal of the Ministry (page 132), that, as regards the number of cases of public insolvency occurring amongst farmers, the pasture areas have suffered more than the arable areas; what are the areas to which he refers; what is the number of the insolvent farmers and the years, and whether, in point of fact, the Ministry, or the author of the statement, in arriving at the above conclusion, was aware of the actual character of the farming operations carried on by the said insolvent farmers?

Mr. Buxton replied that he was informed by the author of the article, who was solely responsible for the views expressed therein, that the statement referred to was based on the geographical distribution of the receiving orders in bankruptcy in the case of farmers in 1922. The number of receiving orders was 287. Of these cases 108, or 37 per cent. only were in the eastern half of England, which, on the whole, is more distinctively arable than the western half. With regard to the last part of the question, the records of public insolvencies do not include any information as to the character of the farming.

Wages, Scotland.—Mr. D. Millar asked the Secretary for Scotland in the House of Commons on 16th April, in how many districts in Scotland agreements had been entered into between the farmers' unions and the farm servants fixing the current rate of wages for agricultural workers; and whether he could specify the rate of wages paid for each grade of worker in each district?

Mr. Adamson replied:—"According to information furnished by the Scottish Farm Servants' Union, I understand that agreements were made at the recent hirings in the Lothians and in the Glasgow district, which includes Dumbarton, West Stirling, Lower Lanark and Renfrew. The terms agreed on are as follow:—

East Lothian.—An increase in wages of 1s. per week for all men and women employed on the farms, and a bonus of 26s. to be payable to all men on the farms, in the event of the average fiars' prices for wheat, oats and barley for 1925 exceeding the average fiars' prices for these grains for the year 1924. This brings the standard for ordinary married ploughmen to 34s. per week, with 16 cwt. of potatoes in the year and house rent free. First men are paid 1s. per week more. Grieves, cattlemen and herds usually receive higher rates, but these vary according to size of farm, etc., and it is not possible to state any standard figure. Women's wages are 21s. per week.

Midlothian and West Lothian.—An increase in wages of 1s. per per week for men and 6d. for women. This brings the standard rate for ordinary married ploughmen to 35s. to 39s. per week, with 12 cwt. of potatoes in the year and house rent free. First men are paid 1s. per week more; the rates for grieves, cattlemen and herds vary as in East Lothian. Wages for women workers range from 19s. to 20s. per week.

Glasgow District.—An increase in wages of 1s. per week to all male married workers. This brings the standard rate to 38s. to 40s. per week, with six cwt. of potatoes and 10 stone of meal in the six months and house rent free. First men receive 1s. per week more."

Agricultural Workers' Wages (Europe).—Mr. Briscoe asked the Minister of Agriculture in the House of Commons on 6th June, whether he had any information showing which are the countries in Europe where wages of agricultural workers are regulated; and would he state whether it is by the State, and what the regulated wages are?

Mr. Buxton replied that in a number of countries in Europe the wages of agricultural workers are regulated under some system of State control. In Hungary and Esthonia the machinery appears to resemble the Trade Board system in existence in this country. He was circulating in the Official Report such information with regard to the various countries as was in his possession. He had no definite information as to the current rates of wages.

Following is the information:—

“The following is a summary of such information with regard to the regulation of agricultural wages in Europe as is in the possession of my Department. The particulars have been collected from various sources, and must not be taken as necessarily complete.

Austria.—In the absence of collective or individual wage contracts, wages must not be less than permanent statutory minima fixed by law.

Belgium.—Individual bargaining is the general rule, with provision for appeal to board of arbitrators. In certain provinces, the decisions of the arbitration boards have force of law.

Czechoslovakia.—Collective agreements (which must be registered with the State Labour Department) must be based on a scheme of labour conditions and scale of wages drawn up annually by the Agricultural Department of the Ministry of Labour. Disputes are referred to joint committees and, if necessary, to arbitration courts.

Denmark.—Wages boards consisting of three conciliators are charged with the duty of administering agreements reached between employers' and workers' organisations. In the event of a dispute the matter is referred to the Permanent Arbitration Court, whose findings have the force of law.

Esthonia.—Provincial Joint Committees meet every year for the purpose of considering minimum rates of wages and the hours of work, their proposals being submitted to the Ministry of Labour, which communicates them to the National Joint Committee. The National Committee examines and co-ordinates the proposals of the provincial committees, which are then, if approved by the Ministry of Labour, published, and assume the force of law.

France.—As in Belgium, individual bargaining prevails throughout the country. Conciliation committees act in cases of dispute.

Germany.—Conciliation boards exist to solve difficulties arising out of collective agreements.

Hungary.—Under an Act passed last year, a system is to be established for the fixing of agricultural wages by district committees (comprising representatives of both sides, and an independent president and vice-president). The rates fixed will be enforceable by law. Pending organisation of the new system, the Act empowers the Minister of Agriculture to fix a minimum rate for 1923 and 1924.

Italy.—Conciliation committees are believed to exist for the settlement of disputes.

Netherlands.—Provision is made for conciliation in cases of disputes affecting 50 or more workers.

Norway.—Settlement of disputes rests with industrial courts.

Poland.—Disputes arising out of collective agreements are dealt with by joint conciliation and arbitration committees. As a temporary measure, a special arbitration Board was set up in 1921 with power to fix wages and working conditions of agricultural labour, and this board has continued to function up to the present.

Sweden.—Machinery has been established for arranging of collective agreement. Any disputes are referred to a central arbitration court, whose decisions are enforceable by the organisations concerned."

REPLIES TO CORRESPONDENTS.

Millipedes.—H.P. enquired the cause of certain damage to celery grown in a greenhouse.

Reply: The specimen is rather small but there are upon it quite sufficient millipedes (*Julus pulchellus*) to account for the damage. Damage by millipedes is not infrequently combined with that of slugs, which are, of course, very troublesome as regards celery. As a rule, the presence of millipedes in such quantity betrays a high content of vegetable humus in the soil. The Ministry's leaflet No. 94, Millipedes and Centipedes, gives some details of life history and suggestions for control.

Dissolving Bones.—K.N. asks how to dissolve bones for manure.

Reply: From old references to the matter it would appear that farmers used to be in the habit of purchasing inch-bones and treating them with sulphuric acid. The bones were placed within a ring of ashes, and after moistening them with water the acid was poured over them and the mass was then stirred with rakes until every fragment of bone was brought into contact with the acid. They were then mixed with the ashes and left in a heap to dry. It will be noticed that in this case the bones had to be broken first. The process is said to have been somewhat awkward and even dangerous. Consequently preference is now given to bones which have been dissolved in properly equipped factories. On the processes there adopted such books as Collins' "Chemical Fertilisers" and Fritsch's "The Manufacture of Chemical Manures" might be consulted.

Indoor Cow-keeping.—L.C. inquires as to keeping cows in stalls all the year round and feeding entirely on bought produce.

Reply: The Ministry is not aware of any herd, outside the towns, which lives "practically entirely on bought produce." Did such exist, it could scarcely be characterised in terms of number of cows kept per acre, as practically no acreage of farm-land would be required for its support. It may be mentioned that when cows are kept on the soiling system, one acre will suffice for two to three cows.

As to the question whether, assuming it to be profitable to purchase all food for a 1,000 gallon cow, any land is necessary for the keeping of cows, the answer is probably to be sought in the practice of the industry. If the method were promising from a money-making point of view it would probably have already been tried all over the country. But the cows would doubtless soon deteriorate and wear out as they do in town dairies.

Grub on Chrysanthemum Leaves.—H.P.W. enclosed young chrysanthemum leaves showing a "blight."

Reply: The insect attacking the chrysanthemum leaves is the grub of a small fly, *Phytomyza chrysanthemi*. This grub or larva lives between the layers of the leaf, making tunnels and feeding upon the tissue. The best remedy to apply is to pick off by hand and destroy the attacked leaves on the very first indication of attack. This will generally prevent further trouble. If the attack once gets a hold on the plants when they have become a fair size, it is extremely difficult to control. A very strong solution of nicotine and soap is then the only remedy. Its effect, however, is sometimes doubtful, and it is also expensive to apply, so that checking the attack in the early stages by the removal of the leaves as indicated is quite the best manner of dealing with the pest.

Vine Scale.—J.H.R. forwarded specimens of a pest which was ruining a vine.

Reply: The pest is the vine scale (*Pulvinaria vitis*), a coccid which occurs not uncommonly on vines both under glass and also out of doors in sheltered places. This can be controlled by spraying or washing the vines thoroughly with paraffin emulsion at the time when the plants are dormant. Other insecticides, such as lime-sulphur, would also prove effective. The Ministry's leaflet No. 352 (Control of Pests of Fruit Trees in Gardens and Small Orchards) gives instructions for making a number of washes, including lime-sulphur.

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ADDITIONS TO THE LIBRARY.

[Readers of the *Journal* who are not aware that certain books and agricultural periodicals may be borrowed from the Ministry's Library should write for particulars and conditions of loan.]

Agriculture, General and Miscellaneous.

Watson, J. A. S., and More, J. A.—Agriculture: The Science and Practice of British Farming. (666 pp. + xxx plates.) Edinburgh and London: Oliver & Boyd, 1924, 15s. net. [63(022).]

Bear, F. E.—Soil Management. (274 pp.) New York: John Wiley; London: Chapman & Hall, 1924, 10s. net. [63.11(02).]

International Institute of Agriculture.—Production et Consommation des Engrais Chimiques dans le Monde. 3rd edition. (266 pp. + 99 charts.) Rome, 1924. Fr. 25. [63.1621.]

International Institute of Agriculture.—Les Offices de Comptabilité Agricole dans les Divers Pays. (529 pp.) Rome, 1924, Fr. 50. [657.]

Canada Advisory Council for Scientific and Industrial Research.—Bulletin 11:—Nitrogen Fixation. (28 pp.) Ottawa, 1924. [668.6.]

Field Crops.

Welsh Plant Breeding Station.—Series H, No. 3, Seasons 1920-23:—Further Investigations with Herbage Plants:—

I. Seasonal Productivity of Herbage Grasses, *R. G. Stapledon*.

II. The Nutritive Value of Grasses as shown by their Chemical Composition, *T. W. Fagan* and *H. T. Jones*.

III. Productivity of Different Strains and Nationalities of Red Clover, *R. D. Williams*.

IV. A Note on Subterranean Clover, *R. D. Williams* and *W. Davies*.

V. Grassland and the Grazing Animal, *R. G. Stapledon*, *T. W. Fagan* and *R. D. Williams*.

(168 pp.) Aberystwyth: University College of Wales, 1924, 12s. 6d. [63.33.]

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NOTES FOR THE MONTH.

In a speech made in the House of Commons on 12th February last, the Prime Minister made the following statement: "The Government propose to support, either by loans or by guarantees, co-operative enterprises controlled by the agricultural community, organised and directed mainly to deal with agricultural produce, the buying of the raw materials, seeds, manure, the buying of implements of cultivation, the supplying of markets, and all those processes necessary to make agriculture a paying and prosperous concern in this country."

**Co-operation and
Credit: Govern-
ment Assistance.**

There are three directions in which steps have been taken to render assistance to agricultural co-operative enterprises in this matter: (a) through the Agricultural Credits Act for the supply of credit, (b) by means of loans to agricultural co-operative enterprises, and (c) by guarantees to larger agricultural organisations under the Trade Facilities Acts.

Agricultural Credit Societies.—The Agricultural Credits Act was passed in August, 1923, and on the initiation of the scheme the rate of interest on loans was fixed at 5 per cent. This made it necessary for Societies to charge 6 per cent. to borrowers, and it appeared likely that this would prove a serious obstacle to the success of the movement. The rate of interest was reduced in March of this year to current Bank rate with a minimum of 4 per cent., so that this obstacle has now been removed.

The Act provides facilities which enable farmers, small holders, allotment holders, and other agriculturists to obtain credit to meet such expenses as the purchase of seeds, fertilisers, feeding stuffs, the purchase of breeding and other live stock, of machinery and implements, the erection of silos, barns, fencing, etc., the purchase of fruit trees, etc.

A leaflet* has been issued explaining the method of forming societies, and if the scheme outlined in the leaflet is taken up it should prove of great advantage to small farmers and others in enabling them to purchase live stock and requirements on extended credit. It is not usually practicable or desirable for a society to be formed exclusively of prospective borrowers, and the method suggested in the leaflet is that such societies can best be promoted through the agency of existing co-operative societies or other organisations, who will take up shares in the Credit Societies without being actual borrowers. Under such an arrangement the share capital subscribed by the co-operative society, or other organisation, combined with the shares taken up by prospective borrowers and with the proportionate Government advance, would put the society on a sound footing.

The advantage of combining a Credit Society with a Co-operative Trading Society is that the loan and the purchase can be made through the same channels at the same time. The object of the loan in the majority of instances will be to enable the borrower to purchase agricultural requisites such as fertilisers, seeds, live stock, implements, etc., and the natural course is to adapt the scheme to the ordinary conditions of agricultural trade in which credit plays a very large part. The adoption of the above proposal by Co-operative Trading Societies would be to the benefit of those farmers and small holders who wished to make purchases on a system of deferred payments as contemplated by the Act, and it would also seem to be to the advantage of Co-operative Trading Societies as it would in effect enable them to provide credit facilities for their customers on a larger scale than they would otherwise be able to offer.

Loans to Co-operative Enterprises.—A sum of £200,000 has been provided by Parliament in order to enable the Ministry of Agriculture to make loans to develop forms of co-operation directed to the preparation and marketing of agricultural produce, such as bacon factories and milk depôts, and a committee of business men and persons interested in co-operation has been appointed to advise the Ministry in regard to the making of these loans. A number of applications are under consideration. The amount of the loan to any one Society under this scheme is limited to £10,000.†

Assistance under the Trade Facilities Acts.—The needs of large undertakings which require more money than can be provided under the above scheme are met by the Trade Facilities Acts.

* No. 311.

† The conditions under which loans will be made are printed at p. 480.

Under the terms of the Trade Facilities Acts the Treasury may guarantee the interest and repayment of loans raised in connection with the carrying out of any capital undertaking, or for the purchase of articles manufactured or produced in the United Kingdom which are required for the purposes of any such undertaking, if they are satisfied that the application of the loan in the manner proposed is calculated to promote employment in the United Kingdom. The guarantees cannot be used for the provision of working capital, nor for the purpose of extinguishing existing liabilities.

Agricultural undertakings which might be eligible for consideration are sugar-beet factories, dairy factories or milk depôts, large bacon factories, live-stock auction marts, fruit markets or other large-scale undertakings dealing with agricultural produce.

Note.—Further particulars of any of the schemes referred to above may be obtained on application to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

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THE Fourth International Seed-Testing Congress was held at Cambridge from 7th to 12th July, and included visits to Rothamsted Experimental Station and the British Empire Exhibition. An excursion programme was also arranged from 14th to 16th July to enable the delegates to visit the warehouse and seed-cleaning plant of the Eastern Counties Farmers' Co-operative Association, Ltd., the seed establishment of Messrs. Sutton and Sons, Reading, and the Royal Botanic Gardens, Kew.

The Congress was attended by official delegates from the following countries: Argentina, Belgium, Canada, Czechoslovakia, Denmark, Egypt, England and Wales, Finland, France, Germany, Greece, Holland, Hungary, Irish Free State, North Ireland, Lithuania, Norway, Poland, Rumania, Russia, Scotland, Sweden, Switzerland and the Ukraine. The International Institute of Agriculture at Rome was also represented, and officials of the United States Department of Agriculture attended.

With one exception the meetings of the Congress were held at the National Institute of Agricultural Botany, Cambridge. The Congress was opened on 7th July by Sir Lawrence Weaver, who welcomed the delegates. Mr. Alfred Eastham, the Director of the official Seed Testing Station for England and Wales,

Cambridge, then read a paper on the work of the Station. The delegates were subsequently entertained at lunch by the Council of the Institute. The afternoon session was devoted to a report by Director K. Dorph-Petersen, of Copenhagen, on the work of the European Seed Testing Association.

On 8th July, Director Dr. A. Volkart, Zurich, put forward a proposal regarding regulations for the European Seed Testing Association; Mr. T. Anderson, Edinburgh, read a paper on Uniformity in Seed Testing Reports; Dr. Y. Buchholz, Christiania, a paper on the Determination of the Water Content of Seed; Professor L. Bussard, Paris, a paper entitled "Should not the percentages by weight of weed seeds, and the names of the species which occur most frequently, be quoted in each purity determination; and which are the species which should always be counted as weeds?"; and Director Dr. A. v. Degen, Budapest, a report on the work of the Dodder Committee appointed at the Copenhagen Congress, and a paper on the Longevity of Seeds.

Papers read on 9th July were by Professor Dr. A. Voigt, Hamburg, on Germination Tests, especially of Clover and Grass Seeds; by Director Dr. W. Franck, Wageningen, on Germination Investigations by Low Temperature; by Director Dr. A. Volkart, Zurich, on the Determination of Origin established by the European Seed Testing Association; and by Mr. Edgar Brown, Washington, and Dr. G. Pammer, Vienna, on Valuation of Hard Seeds and Determination of Broken Seedlings. The afternoon session, held at the School of Agriculture, at which the papers by Dr. Volkart and Messrs. Brown and Pammer were read, was attended by the delegates to the International Seed Trade Conference, which was being held in London concurrently with the Seed Testing Congress.

The morning session of 10th July was devoted to papers by Director K. Dorph-Petersen, Copenhagen, on Investigation of seeds which are not fully matured, and determination of the germinating power in the soil of such seeds; and Director Dr. F. Chmelar, Brunn, and Dr. Gentner, Munich, on Laboratory and field investigations on purity of strain and the investigation of diseases which are transmitted by the seed. The delegates were entertained at lunch by the Master of Magdalene College.

At the afternoon session it was unanimously agreed to extend the scope of the European Seed Testing Association, which was formed at the third International Seed Testing Congress held at Copenhagen in 1921, so as to make it fully international. The

constitution of the new International Association was approved. The object of the Association is the advancement of all questions connected with the testing and judgment of seeds. An Executive Committee and several special Committees to deal with various problems connected with seed testing were formed.

An invitation from the International Institute of Agriculture to hold the next International Congress in Rome was unanimously and cordially accepted, and it was agreed that this should be held during the first half of May, 1927. It is proposed that the Association shall work in co-operation with the International Institute of Agriculture, and arrangements have been made for papers of interest to the Association to be published in the Bulletins of the Institute.

The next day, 11th July, was fully occupied by a visit to Rothamsted, and at 8 p.m. the delegates were entertained at dinner in the Hall of Trinity College, Cambridge, by the British Government, the Rt. Hon. Noel Buxton, Minister of Agriculture, presiding. In extending a hearty welcome to the delegates and other guests, on behalf of the Government, Mr. Buxton said the Government fully recognised the importance of seed testing, and it was felt to be a privilege to be able to hold the Congress at Cambridge. In agriculture rather more than a well-prepared fertile soil was needed. Seed testing was essential to the improvement of seed and to the solution of present-day problems. He paid a tribute to the work of Professor Biffen in producing new wheats, and urged that more of these wheats should be grown in this country. If they were, there would be a great addition to our national resources, and there would be a great economy in transport, as foreign wheat would not need to be transported to the same extent to mix with our home-grown wheat. He hoped and felt sure there would be good results from the meetings of the Congress.

Professor Dr. W. L. Johannsen, Copenhagen, and Dr. A. Volkart, Zurich, replied on behalf of the delegates. The toast to the Chairman was proposed by Dr. Erik Insulander and seconded by Sir Lawrence Weaver. The singing of mediæval pastorals by the Choir of Trinity College, and the singing of Grace at the close of the dinner, greatly added to the interest of the delegates and other guests.

It should be added that both the Congress and the Ministry are greatly indebted to the authorities of Trinity College, Emmanuel College and Selwyn College for their courtesy in lodging and entertaining within their historic precincts so many of the delegates and others attending the Congress.

THE annual expenditure by the State on agricultural research now reaches very considerable dimensions, partly as a result of

**Studies Concern-
ing the Handling
of Milk.**

the provision by the Corn Production Acts (Repeal) Act of the fund of £850,000 for the development of agricultural research and education. A proportion of the annual expenditure (amounting approximately to £130,000) takes the form of annual grants in aid of fundamental and continuing research work carried out at Agricultural Research Institutes, each of which deals with a special subject (soils, plant diseases, fruit growing, dairying, and so on). There are still a few gaps in the scheme of agricultural research, but these are being filled, and the nation may justly claim that it has created an organisation which covers every side of agriculture and has laid the foundations for that complete scientific investigation upon which any great and lasting improvement of agricultural practice must ultimately be based.

A policy which has for its object the increase of facilities for research would be incomplete without arrangements for ensuring that the results of research are made available for farmers. For this purpose a service of specialist advisory officers (entomologists, mycologists, chemists, economists and veterinarians) attached to University Departments of Agriculture and Agricultural Colleges has been established, the country being divided into fourteen provinces for the purpose; and County Councils have appointed agricultural organisers and county agricultural staffs. It is the duty of all these officers to familiarise themselves with the results of research, apply them to local conditions, and bring them home to the best of their ability to farmers in their areas.

Lectures given by University, College, and County lecturers on agricultural subjects to students at Agricultural Colleges. Farm Institutes and audiences of farmers and farm workers aid in the dissemination of new knowledge. Quite recently the Ministry of Agriculture has set on foot, in co-operation with the National Farmers' Union, a scheme by which addresses at meetings of branches of the Farmers' Union are given by the men who are engaged in research work at the different Institutes.

The spoken word has a magic which the book cannot possess, but all things are not meet to be spoken, and the printed word, moreover, can reach those who have no opportunity of hearing lectures. The Ministry has published a large series of leaflets, dealing with every branch of agricultural practice, which are revised frequently to embody the latest results of research; and

every month this *Journal* brings to a considerable agricultural public one or more articles by research workers detailing their methods and results.

Besides the farming community, however, it is necessary also that the wider public should be made aware of the progress of agricultural research; and as much with the object of informing them as the farmer, the Ministry in 1921 directed Mr. V. E. Wilkins to compile a readily intelligible, summary account of practically the whole of the work on which agricultural researchers were then engaged. The resulting book, "Agricultural Research and the Farmer," received a cordial welcome and a ready sale, more than sufficient to encourage the Ministry to proceed with the publication of a series of monographs taking in turn subjects upon which the research worker has something new and valuable to say to the farmer and saying it in greater detail than was possible in Mr. Wilkins' book.

The first monograph of the series,* has been compiled by Dr. Stenhouse Williams and the staff of the National Institute for Research in Dairying. This Institute dates back to 1911, for it was on 30th September in that year that the then Board of Agriculture received a memorandum urging the suitability of Reading as a centre for dairying research, and in reply indicated its willingness to make a two-thirds contribution up to £2,500 per annum towards the cost of such an Institute. The first payment authorised by the Ministry was one of £7 on milk churns, milk, sterilising, etc., in connection with an investigation into the effect of ventilated and unventilated churns on the keeping properties of milk in transit. In 1912-13 the Ministry's annual grant was £1,510, an amount which has gradually increased to about £8,000 a year. The Institute, whose work touches vital questions of public health, is supported also by the Ministry of Health, and the Medical Research Council, as well as by the Royal Agricultural Society of England and the dairy industry.

Large sums of money have been raised by the Institute for capital purposes and the Treasury has, since the war, sanctioned capital grants amounting to £32,000 on the condition that equal sums are raised from other sources. With this assistance, and also largely through the munificence of Viscount Elveden, the Institute has been able to provide itself with new buildings and a farm of its own, where its work will continue and develop

* "Studies concerning the Handling of Milk," Misc. Pubn. No. 41, to be obtained at the Ministry's Office, 10, Whitehall Place, London, S.W.1. Price 1s., post free.

under the best conditions. Further financial assistance from other than Government sources is, however, still a crying need of the Institute.

The subject chosen for this first monograph is of particular interest at the present time in the light of the Milk and Dairies (Amendment) Act, 1922, and the attention which is now given to the production of clean milk. The book has been written in as simple language as possible, and the use of scientific terms has been reduced to a minimum in order that it may be readily intelligible to all classes of readers. It should appeal to a wide public—dairy farmers, milk distributors and sellers, medical men—and, it is to be hoped, to some at least of the milk-consuming public, who are not professionally interested in it. Milk is not consumed either in sufficient quantity or in such a condition of cleanliness as to promote, as it might promote, the health and well-being of the people, who cannot afford to be ignorant of how it is produced and distributed, and of how those things might be better done with advantage to producer and consumer alike.

* * * * *

THE Minister has made an Order, the Foreign Animals Order of 1924 (No. 2), which came into operation on 15th July, requiring

**Prevention of
Introduction of
Foot-and-Mouth
Disease.**

the Master of any vessel which has within 60 days before entry into port carried animals from a prohibited country to any other country, to make a declaration to that effect to the Ministry immediately upon entry into port. The Order further prohibits the discharge of any cargo unless, and until, the landing has been authorised by the Ministry subject, if the circumstances require it, to special disinfection of the vessel or cargo. The Order has been widely promulgated to all concerned. Its object is to prevent the risk of the introduction of foot-and-mouth disease through cargoes of feeding stuffs which may have been contaminated by contact with infected animals or through excreta whilst on board.

* * * * *

THE representations made by the deputation to the Parliamentary Secretary of the Ministry on 14th May from the Local

**Sheep Scab
Regulations.**

Authorities of Scotland and the National Farmers' Union of Scotland, to protest against the proposed regulations forbidding the movement of undipped sheep from Scottish counties into English counties has been carefully considered by the Ministry,

and a reply was sent on 24th June to the effect that, in view of the present position of scab, the Ministry could not see its way to deprive those Local Authorities who are anxious either to eradicate disease from their areas, or to maintain their existing immunity from scab, of their existing powers to make regulations for the protection of their district. A promise was made, however, that if, as a result of the measures taken under the Sheep Scab Order of 1923 to reduce the prevalence of the disease, a more satisfactory position is achieved, the Ministry would consider amending the powers of Local Authorities to make such regulations, in the direction of securing that such regulations should not be applicable to sheep moved from clean counties where those counties took adequate precautions against fresh invasions.

* * * * *

In the July issue of this *Journal* Mr. Alexander Gregg, Lecturer in Agriculture on the staff of the Cornish County Council, put forward a plea for an extension of judging competitions to young farmers at our county shows, and instanced the valuable results obtained and the public interest aroused by the judging events held yearly in connection with the shows at Wadebridge, Truro and Helston. These events include the judging of a fat steer, a long-woolled sheep, six roots, samples of cereals, the identification and naming of grasses, clovers and weed seeds, and the naming and valuing of foods and manures.

Such competitions are a considerable feature of American shows, and it is evident that they would have great educational value for the young agriculturist in this country. A beginning has been made over here in cattle-judging contests. An event of this nature, which has recently taken place, is the third international cattle-judging competition, promoted by the International Federation of Young Farmers' Clubs, which took place in Mr. M. D. Bannister's grounds at Haywards Heath, Sussex, on 11th July last. A selected English team of three girls (all members of calf clubs supported by the United Dairies Limited) competed with a representative American team of three boys for possession of a gold cup awarded by the *Daily Mail*, and a useful comparison could therefore be made between English and American methods of training in this direction.

The company which Mr. Bannister entertained at luncheon before the event was representative of many interests. In addition to members of the Embassy staff the American visitors

included Senator McCormack, Mr. Steele (London Correspondent of the *Chicago Tribune*), Professor Rhode and Mr. Wise (county agent for agricultural extension work in Illinois). Mr. P. B. Tustin (of the International Federation of Young Farmers' Clubs), Captain Skelton, Mr. Holt Thomas and representatives of the Ministry of Agriculture were among the British guests. The speeches opened up inspiring vistas of the opportunities of service which lie before the movement. Senator McCormack, responding to Mr. Bannister's hearty welcome of the American guests, stressed the great educational influence of the clubs in the United States and, speaking both as a practical agriculturist and as a politician, emphasised the contribution of agricultural education to the needs of the industry. Mr. Tustin alluded to the many possibilities of development in this country, and Mr. P. G. Dallinger referred to the sympathy with which the Ministry of Agriculture had always viewed the movement and to the probability of more active support in the future.

The brilliant weather and the interest which had been aroused among the agriculturists and the young people of the neighbourhood combined to make the contest a very pleasant function. The delightful rural setting, the well-turned out cattle and the workmanlike kit of the girl competitors made a pretty scene which attracted many photographers. Professor Rhode and Captain Skelton acted as judges.

The test consisted of the judging of three classes of dairy cattle (Shorthorns, Jerseys, and Friesians). In each case the competitors were given 15 minutes to survey the stock, and then place them in order of merit, reporting to the judges their reasons for the arrangement they had made. The businesslike manner in which the contestants conducted the investigation and recorded their opinions, was the subject of favourable comment from the audience. In announcing the result the judges stated that the American teams were the victors, with a score of 1,590, but that the contest had been very close as the English team had secured 1,484 marks. The English side had done well in the judging of the Shorthorns, but had rather lost ground in the other two classes. The individual totals were given as under:— D. Williams (U.S.A.) 545, J. Gaulrapp (U.S.A.) 530, Winifred Emery (England) 518, E. Folkers (U.S.A.) 505, Mary Banbury (England) 498, Joan Moore (England) 468.

The gold cup was presented to Donald Williams, leader of the American team, by Mrs. Bannister.

The American team, sons of working farmers in the State of Illinois, have visited, by the generosity of the *Daily Mail*,

representative farms and shows during their stay over here, and will carry back with them considerable knowledge of agricultural conditions and agricultural problems in this country. The superior efficiency of the American team is no doubt partly attributable to the greater attention devoted, on the other side of the Atlantic, to the agricultural education of the young. It is to be hoped that the organisation of Young Farmers' Clubs in this country may now be taken in hand on lines more comparable to the system in vogue in the United States. There is splendid material at hand in the young boy and girl farmers of these islands: there is general agreement that the main hope of the countryside lies in the training of the future agriculturist in an intelligent appreciation of country life and of the value of agricultural education. It remains to make the maximum use of the Young Farmers' Club movement, which has already been brought to an interesting stage in this country, and which has attained its fullest development in the United States of America.

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THE Government have now decided that, subject to the necessary funds being voted by Parliament, drainage works for the relief of unemployment shall be continued in the coming autumn and winter. Although no works may be started before 1st October next, there is no reason why applications for grants should not be submitted forthwith, as arrangements have been made for the preparation throughout the summer, by County Agricultural Committees and Drainage Authorities, of schemes for putting into operation next autumn.

In previous seasons the work has been handicapped owing to the conditions not being published until the middle of September or even later. This season the Ministry issued the conditions to all concerned on 25th June, a preliminary notice having been issued some weeks earlier, and it is hoped that the longer time available for the preparation of schemes will be a factor in increasing both their value and their number. Full particulars of the conditions governing the Ministry's grants—which do not differ materially from those applicable in the case of schemes carried out last season—can be obtained from Clerks of County Councils or from Drainage Authorities, but it should be noted that the grants will be available only for combined schemes for the improvement of groups of holdings or properties, and not for field drainage work.

The Ministry has received repeated and striking testimony as to the high value of these relief schemes. It is hoped that all concerned will co-operate cordially in making this season's programme an even greater success than those of the three previous seasons, and at the same time improving the drainage of large tracts of agricultural land in all parts of the country.

THE index number of prices of agricultural produce has risen a further 2 points, June prices being on the average 58 per cent.

The Agricultural Index Number. above those in the corresponding month of 1911 to 1913. There has thus been a rise of 5 points in two months, but prices remain relatively rather lower than in January and February. As compared with last year, however, the figures are now showing a distinct divergence, and there is a difference of no less than 7 points between the June figures in the two years.

In the following table are shown the percentage excesses over pre-war prices each month since January, 1920 :—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911-13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	61
March ...	189	150	77	59	57
April ...	202	149	70	54	53
May ...	180	119	71	54	56
June ...	175	112	68	51	58
July ...	186	112	72	53	—
August ...	193	131	67	54	—
September	202	116	57	56	—
October ...	194	86	59	51	—
November	193	79	62	53	—
December	184	76	59	56	—

The index numbers of all kinds of cereals showed an advance between May and June, although the rise in the case of barley is due to a fall in the basic years 1911 to 1913, barley actually selling on the average at 2d. per cwt. less in June than in May. The June price of wheat is slightly higher than a year ago, and barley shows a decided improvement, but oats are relatively cheaper than last year. All the cereals, however, are now very scarce, and the higher prices are in respect of comparatively small quantities.

As in the case of cereals, potatoes have been in very limited supply throughout June, and, with increasing supplies of imported new potatoes available, demand has been dull with a considerable fall in prices. Average prices in June were 27s. 6d. per ton below those of May, and the index number has declined 45 points on the month. At the same time the average

of prices in June is nearly four times that of June last year, when potatoes were selling wholesale at about 30 per cent. below pre-war prices.

Fat cattle and fat sheep both showed an advance on the month, the former of 4 points and the latter of 6; in each case, however, the rise is accentuated by the fact that prices declined between May and June in pre-war years. Fat pigs also fell between May and June in the basic years, but there has been a relatively greater fall this year and a slight decline in the index number. Both cattle and sheep are a shade dearer than a year ago, but pigs are much cheaper.

All classes of store stock are firm in value, with the exception of store pigs, which have fallen in sympathy with fat pigs and now sell at about 32 per cent. above pre-war as compared with 130 per cent. above pre-war a year ago, when additional firmness was imparted to the market by the heavy stocks of potatoes left over from the previous season's crop.

Eggs and poultry have risen 3 and 6 points respectively on the month, but in the case of poultry the rise is due not to an actual increase in price but to the fact that the seasonal fall this year is relatively smaller than usually occurred before the war.

Milk shows no change either actually or relatively to pre-war, but cheese and butter, although both a shade cheaper in June than in May, have advanced a few points owing to the greater fall normally occurring at this season in pre-war years.

Index numbers of different commodities during recent months and in May, 1923, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

Commodity.	1923.	1924.				
	June.	Feb.	Mar.	Apr.	May.	June.
Wheat ...	38	44	46	38	38	42
Barley ...	17	43	45	48	46	48
Oats ...	41	41	39	35	30	32
Fat cattle ...	52	54	52	49	51	55
Fat sheep ...	83	75	64	75	87	93
Fat pigs ...	69	34	33	35	32	31
Dairy cows ...	50	48	64	63	58	59
Store cattle ...	31	39	41	38	42	47
Store sheep ...	114	89	85	84	96	121
Store pigs ...	130	50	45	42	36	32
Eggs... ...	40	75	68	48	40	43
Poultry ...	87	52	59	70	87	93
Milk ...	53	87	71	58	50	50
Butter ...	33	71	63	51	40	43
Cheese ...	44	72	71	71	77	83
Potatoes ...	-31*	170	173	154	219	174
Hay ...	42	-1*	1	0	4	3

* Decrease.

THE ROYAL SHOW.

THE 83rd Annual Show of the Royal Agricultural Society of England was held at Leicester from 2nd to 6th July. The weather was exceptionally fine, and the number of foreign visitors considerable.

As is usual at this show interest centred in the live stock classes, and this year the interest was perhaps heightened on account of the long period during which our farmers have suffered so severely from foot-and-mouth disease and the attendant restrictions.

As was anticipated the live stock section was seriously depleted in numbers owing to the fear of foot-and-mouth disease, and the policy of some counties of not allowing exhibits to return after the show. In the cattle classes alone no fewer than 500 animals out of an entry of 1,300 were absent, but although reduced in numbers of entries these classes provided a very fine show of cattle, and generally speaking the high standard of excellence expected at this show was maintained.

Cattle.—Shorthorns, the most widely distributed and popular breed in Great Britain, were a magnificent display, and were the centre of much interest during the judging. So long as breeders can produce the type of animal represented in the prize-winning list there is little fear of that popularity declining. In the section of the breed confined to dairy animals, however, there was some evidence amongst unsuccessful exhibits that breeding for milk alone is bound eventually to entail loss of type and constitution.

Numerically, the Lincoln Red Shorthorn classes were not as strong as one might have hoped to see at a show held in Leicestershire, a county which is mainly grazing and dairy lands, and in which this good, dual-purpose breed is rapidly spreading and becoming deservedly popular. Quantity was, however, more than balanced by the quality of the exhibits. Hereford classes were well filled and were conspicuous for uniform excellence, and another famous beef breed, the Aberdeen-Angus, although short in numbers yielded keen competition and made a most creditable show. Of the dairy breeds British Friesians were the most numerous represented, and the classes were very uniform in merit, as also were those confined to Jersey cattle.

Horses.—The entry of horses was one of the largest in recent years, and there were few absentees. At a show in the Midlands

one expects to find the Shire breed well represented, and Leicester proved no exception to this rule. Unquestionably the Shire classes reached an exceptionally high standard, and gave the judges a troublesome and very hard day's work. The result was an impressive display of grand horses in the prize-winning ranks. To anyone who has not attended the Shire shows for some years the improvement in this breed must be obvious. The leggy type, with no "middle-piece," which was formerly too much in evidence, has to a great extent disappeared, and the compact, deep-bodied and massive horse of to-day is no doubt responsible for the increasing interest shown in this breed by visitors from abroad. The Shire geldings also were good, and the judging of these powerful cart horses was keenly followed.

The number of Clydesdales shown was, of course, small as compared with shows held in the northern counties, but the prize list included some fine specimens of the breed. The clean-legged cart-horse breeds attracted much attention and are, no doubt, growing in popularity. Both Suffolk and Percheron have proved their worth as good workers and hardy constitutional horses, and have converted many who thought that an abundance of hair on the legs was an absolute necessity to a cart-horse. The beautifully placed shoulder of the Percheron also catches the eye not only of the heavy-horse breeder but also of the man on the look out for a mare with substance to mate with the Thoroughbred.

Pigs.—In common with the cattle section the pig classes suffered from the large number of absentees, though Large Blacks and Middle Whites were well represented in numbers. The improvement shown in both the Large White and Middle White breeds in recent years is remarkable. The former is now on a much shorter leg and is deeper sided, while the Middle White is a much more lengthy pig than formerly, and the coarseness of shoulder which disfigured this breed is being eliminated. The latter defect, however, is still rather too obvious. There can be no doubt that both these breeds are vastly improved from the bacon-curer's and butcher's point of view as compared with what was considered ideal a decade ago.

Machinery.—The machinery exhibits and stands hold a very good second place in the appeal they make to visitors to the Royal Show. At the recent show the machinery exhibit not only reflected the financial position of the farmer but the latest work in agricultural engineering. There were, for example, many fewer tractors than a few years ago. The American invasion is

now practically confined to a few standard lines, such as the Fordson, the International and the Case. British manufacturers were well represented, although the only striking new design was a rein-driven tractor shown by Messrs. Fowler of Leeds. It was not very clear that this design has any substantial advantages over the standard designs, and it would be interesting to see the machine tried out in the field. At the present level of prices, however, the high cost of this machine is likely to prejudice its sale.

Although tractors were fewer, thrashing machines of the smaller type for use with tractors were much in evidence, while the increased attention which has recently been given to mole draining was reflected in the number of mole ploughs for direct haulage by tractors. Here we have evidence of the general usefulness of tractors to those farmers who retain them, and some indication that the present slump is but temporary.

Cable engines were represented not only by the well-known steam types, but also by an internal combustion engine set of new design by Messrs. Fowler, as well as sets by Messrs. Maclaren and Messrs. Borsig. These sets are, of course, only for the landowner or large farmer.

At the other end of the scale we may notice small petrol engines for barn machinery, water pumping and lighting, the demand for which is clearly increasing. Many firms are manufacturing for this market, and the prices are now within the reach of practically every farmer; the advantages of small engines is such that, even in a period of financial stringency, many purchasers can be found.

The farmer's reduced purchasing power is doubtless responsible for the comparatively small number of new devices. A few items only call for special notice. The design of the potato lifters on exhibition showed marked improvement, particularly with a view to reducing the labour of gathering the crop when lifted. A number of potato planters were also being shown.

Messrs. Ransome's have constructed a "grass rejuvenator," intended to replace the chain harrow, the object being to clear out any matted material, and to give a form of surface tillage to a depth of about $2\frac{1}{2}$ inches. The implement, it is stated, can easily be pulled by three horses, and it could doubtless be as effectively operated by a tractor.

Agricultural Education and Research.—In the Agricultural Education Exhibit, to which a number of representative institutions contributed, the National Institute of Agricultural Botany

showed interesting models and diagrams of the "alternate drill strip" method of testing the yield of cereals in field trials,* and models and tables of the "chequer board" method for testing yield and maturity of potatoes. The use of the leaf index as recently worked out by Dr. R. N. Salaman for testing varieties of potatoes was included in the exhibit. The section illustrating the work of the Official Seed Testing Station was exceedingly modest, and hardly did justice to the importance of the subject.

The exhibit of the Rothamsted Experimental Station was full of interest, among other exhibits being one showing the effects of boron on the culture of leguminous plants in water, and a selection of the Rothamsted publications.

There was a joint exhibit by the Animal Breeding Research Department of the University of Edinburgh, and the Department of Agriculture, University College of North Wales, of sheep breeding, with special reference to wool improvement. The schemes involving hybridisation included one for the improvement of British wools by crossing with Peruvian merinos; those without hybridisation included a scheme for the improvement of the wool of Welsh Mountain sheep with special reference to the elimination of "kemp." One interesting feature of the exhibit had reference to a curious limb deformity causing the death of new born lambs, which was illustrated by photographs and charts.

The Midland Agricultural and Dairy College had a representative exhibit of the work done at the college. The exhibit was divided into four sections:—(1) Agriculture in general, which included a model of the college and station farm; (2) Dairying, including typical specimens of the leading varieties of hard pressed cheese, soft pressed cheese, cream cheese, Stilton and Wensleydale; (3) Chemistry, including samples of mechanical and chemical analyses of typical Leicester soils; and (4) The Advisory Department, dealing with pests and methods of prevention.

The exhibit of the National Institute for Research in Dairying dealt with dairy husbandry, dairy bacteriology and dairy chemistry, and aroused a good deal of interest.

The Adult Agricultural Education exhibit of the Leicester County Council was one on which a great deal of time and thought had been expended, and both in range and quality, as well as in the method of display, it reflected credit on all con-

* See "Trials of New Varieties of Cereals," by E. S. Beaven, this *Journal*, July and August, 1922.

cerned. In an exhibit of this kind, part of which was in the open and part in a tent, it adds greatly to the pleasure and instruction of the visitor when the grouping is good, the description clear, and the space allotted adequate, and we have seldom seen an education exhibit in which all these essentials were more happily blended. The exhibit consisted partly of small plots in the open containing varieties of cereals, grasses and clovers, and forage crops suitable for the county. All the plots were clearly labelled, well cultivated, and in almost all the crop had done exceedingly well. There was a demonstration allotment illustrating the most useful method of cropping for the small allotment in Leicestershire. The condition of the crops throughout was exceedingly good and evoked a great deal of favourable comment, and the model—a well-deserved title in this instance—attracted a great deal of attention.

A small poultry farm was exhibited below the allotment in which the following breeds were represented: White Leghorn, Black Leghorn, Rhode Island Red, Barnevelder and White Indian Runner ducks. The birds were lent by breeders in the county, and were suitably housed and provided with wired-in grass runs.

In the tent were exhibits illustrating practically all the branches of work undertaken by the agricultural staff, and careful and successful staging added very greatly to the educational value of each section of the exhibit. It is not possible to refer to them in detail, but the improvement of grassland was illustrated as usual by specimen turves; diseases of plants by preserved and fresh specimens; and there was an unusually interesting exhibit illustrating poultry diseases.

An exhibit such as that of the Leicestershire County Council demonstrates very clearly what a useful opportunity may be afforded by the agricultural show to make known the work which is being done in the interests of agriculturists in a county, and although the preparation of such an exhibit as this must have made considerable calls on the time of the staff at a very busy season of the year the results afforded ample justification for it.

Roots and Seeds.—The plant breeding exhibits of the leading seedsmen proved how widely the farmer has accepted the results obtained by the research of agricultural scientists and how extensively the trade has developed this branch of agriculture.

The modern farmer realises that pedigree strains of seeds are as important as pedigree breeds of live stock, and is taking increased interest in the quality and productiveness of all kinds

of seeds. With the present high production costs high yields are essential. By means of cross-fertilisation and pure line selection new and improved varieties are produced each year: improvement is seen not only on the lines of increased yield but in milling qualities, feeding value, non-liability to lodge, and adaptability to certain soils and climates.

In the past most attention has been directed to the improvement of cereals, both on account of the large acreage grown and the relative high value of the crop. A high standard has now been reached, and the majority of farmers are already familiar with the existing improved varieties of cereals. For the coming season, however, the seed of the following new wheats will be available, in addition to several improved types of existing varieties of other cereals:—

(1) Yeoman II, similar to Yeoman in general characters and milling properties, but promising a higher yield.

(2) A selected sort of Wilhelmina, a new white wheat, specially adapted to heavy land in high condition, such as highly manured hop yards or gardens of Worcester and Hereford. It is claimed that whilst yielding as well as Wilhelmina, it has the advantage of being shorter in the straw, with the ear shorter and more closely packed, while it is not liable to lodge even under conditions most favourable to lodging.

(3) Svalof Iron Wheat No. 3, similar to Iron No. 2 but producing a heavier yield.

Perhaps the most marked advance has been made in the improvement of the varieties of roots. An exhibit of particular interest illustrated the development of the mangold, showing roots representing the old types of mangold and the improved strains of Red Intermediate, Yellow Globe, Golden Tankard and Sugar Mangold, indicating the great improvement in external characters. Still further improvement achieved in recent years, not obvious to the eye but of greater importance, was illustrated by figures showing the higher percentage of dry matter and sugar contained in mangolds obtained by selecting stocks. Seed can now be purchased on the basis of the feeding value per acre of the crop.

Since the advent of wild white clover increased attention has been given to the composition of seeds mixtures and the detailed study of grasses and clovers. Experiment has confirmed a common observation, namely, that indigenous plants are often found superior to ordinary commercial strains in certain valuable characteristics. Exhibits were staged showing carefully selected

strains of English perennial rye grass, French Italian rye grass, and Timothy characterised by an upright habit of growth and leaf development which is absent in the typical commercial seed from Ireland. These indigenous strains produce a more nutritive crop and encourage the growth of clover.

Plants giving the most foliage produce the least seed, and the tendency to produce commercially high seed-yielding varieties has resulted in the promotion of stem and flower production to the detriment of leaf production.

British Wool.—Having regard to the importance of wool in the industry of this country, the question of the utilisation of home-grown wool is a most attractive one. Especially is this so when so much of the best and most highly-priced wool used in our factories is obtained from overseas, and it has become an important economic problem to replace some of this by British wool.

The number of breeds of sheep in this country is so large, and the wools from their fleeces are so various, that for the purpose of experiments designed to produce better cross-bred wools for the English market, we have an unrivalled quantity of material. There are two problems: (1) the better preparation, grading, and selling of the various herd-wools as they exist to-day, and (2) the improvement of British wools by crossing with Merino and other fine-woolled varieties. Both aspects, but mainly the first, were dealt with by Professor Barker in an exhibit covering "The Nature of British Pedigree Wools," put up on behalf of the Royal Agricultural Society and the Leeds University. The nature of the wool was "as revealed by fibre examination," and by experiments with typical wool and worsted yarns and fabrics produced from each breed, including experiments in shrinkage and dyeing.

The exhibit was well staged in a large and well-lit pavilion. On the walls of one side and one end were typical woolled skins, representative of 27 native breeds, on each of which the qualities of wool on the fleece were mapped out by tape outlines enclosing figures indicating their excellence. Below the skins were photographs of typical specimens of the breeds, and several samples were shown of woollens and worsteds produced from the wool of each breed. Imposing and exhaustive as this section of the exhibit was, it formed only a part of the whole. A great deal of attention had been given to the fibre measurement of each breed, and the results were illustrated by diagrams and by the listing of the breeds according

to the average fineness of the wool produced. There were also samples of cloth showing the variation in the amount of shrinkage in materials produced from different varieties of native wool, and a complete range of samples illustrating the effect of dyeing.

On the question of improvement of breeds, the exhibit included photographs of breeds of sheep in relation to the crossing of wool strains, and illustrative of other interesting and historical matter. There can be little doubt that the exhibit was of the greatest interest and value to the sheep farmer.

Horticulture.—Regular visitors to the Royal Show who are interested in flowers must have noted with pleasure the growth of the horticultural section in recent years. This year the section was particularly attractive and on a larger scale than hitherto. It was organised by the Horticultural Committee, of which Sir Gilbert Greenall, Bart., C.V.O., was Chairman, Sir Arthur Hazlerigg, Bart., Director of the Horticultural Exhibit, and Mr. Peter Blair, Official Manager. The exhibit, stages in two large marquees, consisted of (a) a competitive group, and (b) a non-competitive group.

There were in all ten competitive classes in which substantial prizes were offered for collections of the more popular cut flowers, such as delphiniums, carnations, sweet peas and roses, pots of tuberous begonias and orchids. The individual exhibits, which were of an exceptionally high standard were put up by the well-known specialist nursery firms. Amongst the non-competitive exhibits there was an excellent terraced garden suitable for a country mansion; and brilliant displays of sweet peas, roses, carnations, canterbury bells, rhododendrons, and of almost every garden flower. There were pots of growing fruit trees laden with cherries, plums, pears and apples; baskets of large and delicious strawberries of many varieties; and most excellent specimens of garden vegetables. This section attracted many visitors who were busy noting down names of choice roses, favourite sweet peas, and of other flowers, fruit, and vegetables for home culture; in that sense the Section must have been an asset to those who are unable to visit the large horticultural shows held in London, York and Shrewsbury.

Exhibits of horticultural interest could also be found in many parts of the exhibition. In the Agricultural Education tent the National Institute of Agricultural Botany had an important potato exhibit where one could see bottled and pre-

served specimens of some of the newer immune varieties, learn from the leaf measurements how to distinguish varieties, and study the correlation between flower characters and colours of tubers. From the Rothamsted Experimental Station exhibit one learnt of the important influence of small quantities of boron on the flowering and fruiting of peas, beans and scarlet runners. One part of boric acid in two-and-a-half million parts of water produced superior plants to those grown without boron. On the Midland Agricultural College stand one was able to see potato plants in pots manured with different potassic fertilisers, and from a study of charts to learn that the College had found the most economical dressing for potatoes on the college farm to be 12 tons of dung together with 10 cwt. of a mixture in the proportion of 3 parts superphosphate, 1 part sulphate of ammonia, and 1 part sulphate of potash.

In the Implement Department exhibits of spraying machines, potato diggers, potato sizing machines, rotary diggers, fruit plantation cultivators and lawn motors were numerous and comprehensive. During the past few years the lawn motor has undergone many changes, and power mowers of large and small sizes to suit varying needs are available.

The time at which the show is held makes it impossible for the Society to offer prizes for fruit. There was held, however, a most excellent competition of orchards and fruit plantations confined to an area comprising the counties of Hereford, Worcester, Gloucester and Warwick, and no fewer than 75 orchards were entered for inspection by the two judges, Mr. Cuthbert-Smith (Kent) and Mr. A. W. Turner (Somerset). These competitions encourage growers to interest themselves in orchard management and the orchard foreman to take pride in his craft, and though they bring difficulties in organising and there is nothing to present on the show grounds, they are worthy of further development.

The Working Dairy.—The working dairy was conducted on lines similar to those which have been adopted for several years past. No practical competition between trained workers in dairying was provided. Instead, the whole of the working dairy was devoted to demonstrations, explained from time to time by short lectures, and to carrying out various tests, *e.g.*, testing the weights of butter obtainable from equal quantities of milk from the various dairy breeds exhibited. The Royal Agricultural Show is the occasion which probably provides the best opportunity for comparing the behaviour of breeds in certain

respects when kept under the same conditions, and for this reason it is commendable that advantage should be taken of the opportunity. On the other hand, there is some justification for the criticism, that the circumstances under which the tests are conducted do not lend themselves to obtaining reliable information. However true this may be normally, they do reflect the behaviour of different breeds when under agricultural show yard conditions.

There are two schools of thought regarding the wisdom of the Royal Agricultural Society in excluding from the programme of the working dairy competitions between skilled technical workers in such arts as butter-making. Almost every other agricultural show provides these competitions and they invariably prove a popular feature. It is true, however, that unless they are carefully organised such competitions may become the hunting-ground of competitors who make it a business to proceed from show to show. Where it is thought necessary, however, to prevent action of this kind it is a comparatively simple matter to arrange the conditions so that such persons are excluded. There is much to be said in favour of holding competitions in technique, particularly if they are so designed as to encourage specially those workers who have undergone recent training.

Clean Milk Production Demonstration.—This is the second year in which the Royal Agricultural Society has provided separate and special accommodation for the provision of practical demonstrations of the production of clean milk. The accommodation at Leicester was in every way satisfactory. These demonstrations were very effectively provided by the staff of the National Institute for Research in Dairying, and proved to be a source of great interest to dairy farmers and stockmen as well as to the general public. On two occasions on each day the whole process of producing milk in a correct manner was demonstrated, and at other times the staff was fully occupied in answering inquiries by farmers and others interested.

Farmers' Milk Competition.—A milk competition, which was conducted outside the show ground but in connection with the show, is worthy of mention, namely, the Farmers' Milk Competition. In this, prizes and awards of merit were offered to farmers who supply milk from the counties of Leicester, Rutland and Northampton to anywhere within the city of Leicester. In this competition there were three classes—the first for farmers who are licensed producers of graded milk (Certified or Grade A); the second for farmers supplying 46 gallons of milk

and upwards per day in two deliveries, and the third limited to smaller producers supplying from 10 to 45 gallons per day. The prizes and awards of merit in connection with these competitions were awarded on a scale of points based upon the condition of the milk in respect of its chemical and bacteriological analyses as it arrived in the city. In all 22 entries were received for this competition.

Butter and Cheese Classes.—The competitive exhibits of dairy produce covered 6 classes for butter and 15 classes for various types of cheeses. On the whole, the competition in these several classes was less than might have been expected. In the six butter classes the total entries were 59, an average of rather less than 10 per class, and in the 15 cheese classes the total entries amounted to 144 or an average of 9.6 per class. The two classes best patronised were those for Stilton cheese, where the total entries were 17 and 19.

Following the procedure of several years past, the butter classes were judged on a scale of points designed by the Society. A card showing (a) the maximum scale of points possible to be obtained and (b) the actual points awarded by the judge is placed with each exhibit immediately the judging has been completed. The Society deserves commendation for the adoption and continuance of this educational method of examining and deciding upon the merits of the respective exhibits in that the system shows to those interested, and especially to the competitors themselves, the reason for success or failure as the case may be. It is the means of turning what is often a competition with no educational value into one of material assistance to producers. The scheme is capable of much wider application than is generally practised. It might, for instance, be applied with almost equal advantage to the judging of the cheese competition. The scale of points used is as follows:—

Aroma and flavour	...	50 points.
Texture	... ..	15 ..
Grain	... ..	10 ..
Colour	... ..	15 ..
Appearance and finish	... ..	10 ..

		100 points.

Ministry's Exhibit.—As usual at this Show the Ministry had a pavilion in which were exhibits illustrating various matters of importance to farmers, *e.g.*, clean milk production, agricultural credit, small live stock, insect and fungus pests, seed testing, weeds, rat destruction and other subjects.

THE SOURCE OF OUR SEED SUPPLY: WITH SPECIAL REFERENCE TO CLOVER AND GRASS.

C. B. SAUNDERS,

Late Director of the Official Seed Testing Station.

ONE of the provisions of the Seeds Act, 1920, requires a statement to be made in the case of a sale of certain kinds of seed regarding the country of origin. The main object of this is to place in the farmer's hands information which may be of value to him. It is generally recognised that home-grown seed, when available, is likely to give the best results in the majority of cases, though for certain purposes special foreign strains are sometimes favoured, and for these reasons the farmer should be interested in the origin of his seed.

A casual inspection of a seed merchant's catalogue will indicate that various British possessions and foreign countries supply the farmer with much of his seed, but there is no readily available information regarding the part played by imported seed nor are there any collected figures which show what proportion of this imported seed is supplied by the different seed growing countries. For this reason some attempt is here made to bring together the rather scanty statistical data available on the subject, and, with the help of information from other sources, to give some general idea of the present position of our seed supply. It is not proposed to touch upon the important side issue of the special advantages of home-grown seed and the desirability of increasing the home output.

Imports of Seed.—Before coming to the main question for consideration it is desirable to refer briefly to the volume of the external commerce in seed of the United Kingdom. The figures in Table I summarise the quantity and value of the six categories of seed into which the Customs and Excise authorities divide our imports and exports. These figures have been extracted from the Annual Statement of the Trade of the United Kingdom and are at present available in this form for the years 1920, 1921 and 1922. Previous to 1920 a different classification was in use and the complete returns for 1923 are not yet published. Figures for cereals and pulses are not included in Table I since the returns make no distinction in the cereal and pulse statistics between seed for sowing and seed for human and animal consumption.

It will be seen that our total imports of seed are very considerable and amount in annual value to about $1\frac{1}{2}$ millions sterling. Exports reach a total of just over half a million sterling. The bulk of the exports consists of seed described as "produce of the United Kingdom" but this probably includes some foreign seed which has been passed into warehouse and cleaned in this country.

Clovers bulk largely among the imported seed and the net income (import minus export) of this class of seed is about 6,000 tons a year. It will be noted that the value per ton of imported clover seed (see also Table II) is greater than that of exported seed and this is no doubt largely due to the export of low-grade seed and cleanings to the Continent. In the case of grasses the exports usually more than counterbalance the imports in bulk. This is due to the large export of ryegrass. As this seed is of lower value than most other grass seeds we naturally find that the ton value of imported seed is very much greater than that of exported seed.

We usually export rather more vegetable seed than we import, but the trade in flower seed and in vetches is almost entirely an import one.

Table I also shows the gradual decrease in the value of seed during the last three years. This can better be shown by comparing in tabular form the value per ton of the more important kinds over this period. See Table II.

Our main inquiry resolves itself into two questions:—

(a) From what countries and in what quantities is this imported seed obtained?

(b) What relation does imported seed bear to the home-grown supply?

It will be convenient first to discuss these two questions on general lines and subsequently to deal with individual species.

Countries of Origin.—The first question is answered to some extent by the Customs and Excise returns. The information here found, however, is only of limited value since there is no subdivision of the six groups of seed mentioned in Table I though, on the other hand, a fairly complete geographical subdivision is made. As the total amount of imported seed varies from year to year according to our home requirements it will be more convenient to express the quantities received from different countries as percentages of the total import. As mentioned above, figures for 1920-22 are available and those for the main groups have been reduced to this form in Table III. There will obviously be seasonal fluctuations in the exports of any variety

from any country, depending upon crop, local requirements and other factors but, taking one year with another, the figures show, on the whole, considerable agreement, and it is suggested that the mean of these three years will give a fairly good idea of the average position.

It must not be assumed that all seed imported from a given country is necessarily grown in that country, since there may be re-export to the United Kingdom of seed imported from another country. It appears, however, that over the three-year periods for which the figures are given any adjustment necessary to allow for this would be relatively slight except in the case of some of the Mid-European States. The difficulty in the latter case is avoided in the clover section of the Table by grouping Germany, Czecho-Slovakia and Austria-Hungary into one area, though separate figures are given in the returns. Some proportion of the Canadian export passes through U.S.A. ports and may possibly appear in the returns as produce of the United States. It should be noted also that some of the seed imported into the United Kingdom is re-exported, but the amount is relatively small and would not materially affect the percentage figures.

Table III only carries our first question part of the way, since the groups are not subdivided. It has been found possible, however, to dissect the clover and grass figures with a reasonable degree of accuracy with the help of official statistics and private information from some of the exporting countries, and thereby to obtain figures for each species representing the percentage of the total import coming from the more important sources of supply. These figures are given below under the variety sub-headings. In the case of vegetable seed it was found impossible to get much statistical information and the figures given are mainly estimated.

Proportion of Seed Imported.—Whilst we have the official figures previously referred to for the import and export of seed there is unfortunately no statistical information regarding home production and consumption. With certain crops, like mangold, one could make a very close estimate of seed requirements from a study of the Agricultural Returns for acreage under different crops, but in most cases where this can be done the seed is almost entirely home grown and consequently the question of the part played by imported seed does not arise. The difficulty is with clovers and grasses, which form the bulk of the imports: any estimate of seed requirements based on acreage would involve

so many assumptions and possible sources of error that it could have little value.

When we come to home production of seed we have not even figures to form a basis for these assumptions. It will be understood, therefore, that it is impossible to advance an accurate statistical basis for an estimate of the relationship between imported and home-grown seed. Furthermore, this relationship will show a fairly wide seasonal variation for some kinds of seed, depending as it does upon the success of the harvest in the United Kingdom. In the case of each species, however, an estimate is made below and in the case of clovers and grasses it is probably not far wide of the mark where the supply comes from abroad either to a very large or to a very small extent. It is given with greater reserve in the case of seeds like red clover or dogstail where the preponderance of home-grown or of imported seed is not very great and where the size of the home-grown crop is the deciding factor.

With these general observations we can now turn to the individual species. Under each heading will be found some estimate of the proportion that imported seed bears to the total requirements of the United Kingdom and also figures which represent the part played by the principal sources of supply. As previously explained the latter figures are based largely on statistical information except in the case of vegetable seed.

Red Clover.—The average import of red clover is from 3,000 to 3,500 tons, that is to say, it forms nearly half of our total clover imports. The amount of home-grown seed varies so greatly from year to year that opinions differ widely as to our average production. An estimate, that a quarter to a half of our requirements is imported, is therefore made with considerable reserve. The imported seed is almost all of the broad red type, as opposed to late flowering red, which is entirely home grown apart from small supplies from America and Scandinavia. The broad red clover is supplied by various countries in the following approximate percentages:—France 35, Chile 35, Mid-Europe 12, U.S.A. 9, New Zealand 5, other countries 4.

Alsike.—Only a small proportion, less than 10 per cent., of our alsike is home grown. Canada supplies at least 75 per cent. of our imported seed, and four-fifths of the remainder comes from Mid-Europe, particularly Czecho-Slovakia.

White Clover.—Genuine wild white clover is exclusively home grown, but one-half to two-thirds of the supply of ordinary white clover is imported. About two-thirds of the imported seed comes from Mid-Europe, *i.e.*, Germany, Poland and Czecho-Slovakia, whilst the remainder comes from the U.S.A. and from New Zealand, the former country sending about twice as much as the latter. The proportion of white clover arriving from New Zealand is likely to increase as its value becomes better known.

Trefoil.—Trefoil is almost entirely home grown, the imported seed from Germany and Holland forming not more than one-tenth of the total supply.

Lucerne.—There is not yet much lucerne seed saved in this country and probably quite 90 per cent. of the seed used is imported. Southern France is the main source of supply, the so-called Provence lucerne forming at least three-quarters of the import. A certain amount of seed comes from North and South America and the Mediterranean, but Turkestan lucerne, about which much was heard a few years ago, has largely disappeared from our markets.

Sainfoin.—A considerable amount of sainfoin is imported every year from France. This is mainly the giant form, seed of the common variety being largely home grown.

Birdsfoot Trefoil and Kidney Vetch are almost entirely supplied by France, whilst *Suckling Clover* is mainly home grown.

GRASS SEED.—*Perennial Ryegrass*.—Apart from a few hundred tons imported annually from New Zealand, at least 90 per cent. of our perennial ryegrass is home grown. Northern Ireland and Ayrshire are, of course, the principal growing areas.

Italian Ryegrass.—Probably about 80 per cent. of the Italian ryegrass used is home grown, this coming mainly from Northern Ireland. France (70 per cent.) and Denmark (30 per cent.) send us about a thousand tons annually, but the Danish supply seems to be decreasing, this no doubt being largely due to the increased attention devoted to cocksfoot.

Cocksfoot.—Cocksfoot is almost entirely imported, 85 per cent. of it coming from Denmark and 10 per cent. from France. A little comes occasionally from the United States, but the import from New Zealand, which was formerly considerable, has now almost ceased. The annual import is about 2,000 tons.

Timothy.—Timothy is also almost entirely imported though a little is grown in Scotland. The United States sends about 85 per cent. of the supply, whilst Canada sends 10 per cent. and Germany the rest. The annual import is from 1,250 to 1,500 tons.

Meadow Fescue.—About 250 to 300 tons are imported annually, of which 80 per cent. is Danish, and the rest is American and Canadian. There is no home-saved seed.

Dogstail.—New Zealand is the only country exporting this seed to the United Kingdom in any quantity, and the amount imported depends largely upon the volume of the Irish crop. On an average perhaps a quarter of the total supply is imported.

There is practically no home-saved seed of the following grasses:—

Rough-Stalked Meadow Grass is almost entirely supplied by Denmark, 30 to 35 tons a year being sent to this country.

Smooth-Stalked Meadow Grass.—The United States supplies the whole world with this grass, it being their Kentucky bluegrass. The annual requirements of this country will be in the neighbourhood of 30 tons.

Wood Meadow Grass.—This seed is obtained from Holland and Germany, the former country supplying the better quality.

Small Fescues.—Hard and sheep's fescues are mainly imported from Germany and its neighbouring states. These grasses are to some extent grown for seed crop purposes, and probably most of the seed reaching this country is so produced, but some seed is still hand collected from waste places. The import of Chewing's fescue (a form of red fescue) from New Zealand is not as great as it was formerly, largely owing to the loss of germination during the voyage to this country.

Bent Grasses.—The true creeping bent is largely hand collected in Mid-Europe and is usually of a somewhat mixed nature. Some of the other forms, such as Rhode Island bent, are cultivated in the United States, but as they are less valuable for British purposes the import is slight.

Meadow Foxtail is obtained mainly from Finland and Sweden, some seed also coming from Holland.

Tall Oatgrass and Golden Oatgrass are supplied by France (mainly) and Holland. The former is cultivated for seed purposes, but the latter is mainly hand collected.

Sweet Vernal Grass.—The best seed is obtained from Holland; the German seed, being largely hand collected, is liable to be mixed with the annual form (Puel's Vernal), which is quite useless.

ROOT AND VEGETABLE SEED.—*Crucifers.*—With the exception of cauliflower most of the field and garden crucifer seed is home grown, not more than 10 to 20 per cent. being imported for home use. A certain amount of cabbage, turnip and swede seed comes from Denmark and Holland, whilst cauliflower is imported very largely from Italy.

Mangold is mostly home grown.

Beet.—The amount of home-grown beet is increasing owing to the unreliability of some of the foreign stocks. About a quarter of the supply still comes from France (mainly), Holland and Denmark.

Carrot and Onion.—About 80 per cent. of the seed of these crops is imported, mainly from the U.S.A. and France. Some carrot seed is also received from Denmark and Holland.

Parsnip is mainly home grown.

**Peas.*—Maples and Greys are mostly home grown, but of the culinary varieties about two-thirds of the supply is imported, the U.S.A., New Zealand, Canada, and latterly Japan, being the principal sources.

**Beans.*—Field and broad varieties are mainly home grown; a small quantity of broad bean seed, however, is supplied by Spain, Morocco and Holland. About half the supply of runners is imported, Holland and, latterly, Poland being the main producers. Most of the dwarf bean seed is imported, France, Australia and British East Africa supplying the bulk of our requirements.

* These are not included among the vegetables in the Tables.

TABLE I.—AMOUNT AND VALUE OF IMPORTED AND EXPORTED SEED FOR THE THREE CALENDAR YEARS, 1920, 1921 AND 1922.

	1920.		1921.		1922.	
	Tons.	Thou- sands of £.	Tons.	Thou- sands of £.	Tons.	Thou- sands of £.
IMPORTS.						
Clover	7,219	1,263	7,253	798	6,848	575
Grass	6,977	752	5,327	481	8,848	553
Vegetable	2,275	287	1,495	162	1,970	170
Flower	301	72	186	54	151	37
Vetch	379	10	284	7	3,880	73
Other sorts	5,594	372	715	63	1,035	67
Total	22,745	2,756	15,260	1,565	22,732	1,475
<i>In 1923, 15,179 tons of Clover and Grass valued at £926,138 were imported.</i>						
EXPORTS.						
Clover U.K. produce ..	1,005	140	727	63	732	46
" re-exports	1,037	191	507	58	330	33
Grass U.K. produce ...	7,804	296	7,201	230	7,945	252
" re-exports	481	60	475	54	255	23
Vegetable U.K. produce	2,192	298	2,227	223	2,701	173
" re-exports	297	54	207	43	741	65
Flower U.K. produce ...	51	20	41	16	39	11
" re-exports	6	1	5	1	2	1
Vetch U.K. produce ...	374	16	33	1	52	1
" re-exports	2	—	2	—	24	—
Other sorts U.K. produce	1,772	166	1,083	44	1,588	67
" re-exports	348	22	70	7	83	7
Total	15,369	1,264	12,578	740	14,492	679

TABLE II.—VALUE IN POUNDS PER TON OF IMPORTED SEED AND OF EXPORTS OF HOME-GROWN SEED FOR THE YEARS 1920 TO 1922.

	1920.	1921.	1922.
	£	£	£
Clover —Imports	175	110	84
" —Exports	139	87	63
Grass —Imports	108	90	63
" —Exports	38	32	32
Vegetable—Imports	126	109	86
" —Exports	136	100	64

In 1923 the value per ton of imported Clover and Grass combined was £61.

TABLE III.—QUANTITY OF SEED RECEIVED FROM THE PRINCIPAL SUPPLYING COUNTRIES EXPRESSED AS A PERCENTAGE OF THE TOTAL IMPORT.

	1920.	1921.	1922.	Average of the 3 years.
CLOVERS.				
France	33	26	15	25
Mid-Europe	20	12	29	20
Chile	10	27	16	18
Canada	13	15	20	16
U.S.A.	13	9	10	11
New Zealand	3	5	2	3
Other Countries	8	6	8	7
	100	100	100	100

	1920.	1921.	1922.	Average of the 3 years.
GRASSES.				
Denmark	40	41	29	37
U.S.A.	27	28	20	25
France	13	10	20	14
Germany	8	10	8	9
New Zealand	4	2	16	7
Canada	1	4	3	3
Other Countries	7	5	4	5
	100	100	100	100
VEGETABLES.				
France	26	29	54	36
Holland	20	27	22	23
Denmark	21	12	3	12
U.S.A.	11	6	4	7
Other Countries	22	26	17	22
	100	100	100	100
FLOWER.				
Holland	32	54	37	41
U.S.A.	32	31	25	29
France	12	8	19	13
Other Countries	24	7	19	17
	100	100	100	100

* * * * *

ROTATION OF CROPS.

II.

PROFESSOR R. G. WHITE, M.Sc.,
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Development of British Rotations.—Under primitive conditions the earliest system of cropping would be continued cultivation of a selected piece of land with a corn crop, and the abandonment of this land when it became no longer reasonably productive. A new piece would then be cleared or broken up, and cultivated, until it in turn became too foul or exhausted. In some western districts, particularly in Wales, this method of cultivation continued until comparatively recent times. In the drier lowland districts of England, more suited for arable cultivation, and for maintaining a large population, permanent settlements and villages were formed even in early times. Regular rotations on the village farms were enforced under the Manorial system, and these continued with little variation on the open field from the time of the Norman Conquest to the middle of the eighteenth century. The most common rotation was as follows:—

First Year: Winter corn, principally rye and wheat.

Second Year: Barley, oats, peas, beans, flax, etc.

Third Year: Fallow.

The fallow given every three years enabled the land to be kept moderately clean, and to remain in cultivation for a considerable period, though the lack of adequate manuring kept production on a level which, judged by modern standards, was extremely low.

Three Course Rotations.—The basis of the old English three-course system can still be traced in some parts of the country on clay soils, where it is difficult to secure for roots the necessary fine seed-bed without great trouble and expense, and where folding the crop with sheep in a wet autumn or winter would be disastrous to the tilth of the soil for some time to come. On real clay soils even carting off a crop of mangolds may so seriously poach the land that it does not recover for some years. The basis of rotations on such soils is generally the fallow followed by two corn crops, the first of which is nearly always wheat. Generally, however, the proportion of fallow, which in the old system was one-third, is considerably reduced by taking a crop of clover, mixed seeds or beans instead of the fallow as frequently as possible, and also introducing a certain area of roots where there is a prospect of fair success. Such rotations are, however, not followed over any great stretch of country, as the inadequate supply of roots makes it difficult to convert the straw into manure, and the heaviest classes of soil have, in recent times, been largely laid down to grass. It may therefore be said that most modern rotations really date from the end of the eighteenth century, when the Norfolk four-course rotation came into general use.

Norfolk Four-Course Rotation.—During the latter half of the eighteenth century the cultivation of roots and red clover became part of the best agricultural practice, and these were incorporated in the Norfolk four-course rotation, roots—barley—clover—wheat, on which most of our systems are based, and which still persists unchanged in so many districts that it may be described as the typical English rotation. The cultivation of roots in rows made it possible on all but the heaviest soils to combine the benefits of the old bare fallow with the provision of a large weight of food suitable for the winter feeding of stock. This enabled the farmer to fatten cattle and sheep in winter, and to produce manure with which to maintain the fertility of his land. The introduction of red clover not only added to the stock carrying capacity of the farm, but also to its general

fertility. Clover, in common with other leguminous crops, such as peas, beans and vetches, is able to secure nitrogen from the air and the soil is thus enriched directly by the store left in its roots, and indirectly by the manure made by animals consuming the herbage or hay. In the case of phosphate and potash, the other important manurial ingredients, there is no similar means of making good the constant loss caused by the sale of crops from the farm. Many British soils contain ample supplies of available potash, but the majority are not too well provided with phosphates, so that the chief thing necessary on most soils to make the four-course rotation a perfect means of building up soil fertility is the addition of phosphatic manure. Towards the middle of the nineteenth century the extensive manufacture of superphosphate filled this need. On the lighter soils, where potash is often badly needed, the conditions necessary for full productiveness could not be completely satisfied until the discovery of continental deposits of potash salts later in the century.

Arrangement of the Norfolk Four-Course Rotation.—The exact arrangement and treatment of the crops in the rotation at the present time varies a little in different districts, but generally the root crop consists mainly of swedes and turnips, which may or may not receive farmyard manure, but are nearly always liberally treated with superphosphate or other phosphatic manure. Usually about half the crop is fed on the land to fattening sheep. In the dry climates and soils where the rotation is generally found, the succeeding crop of barley is not likely to be too heavy, and red clover is sown at the same time. A little Italian ryegrass, and some other kinds of clover are often sown along with the red clover, or, if there is any danger of clover sickness, a mixture, from which red clover is altogether excluded, may be substituted. In the following year the clover or seeds may be either mown for hay or grazed by sheep, the latter being perhaps the more common practice. In preparation for wheat, the clover is ploughed up in early autumn, and may first receive a dressing of farmyard manure. The wheat thus receives not only the farmyard manure, but also the nitrogen stored in the roots of the clover, and the residue from the manure of the sheep folded on the land two years previously, so that satisfactory crops can be grown even on comparatively poor light soils. After the wheat has been harvested, the stubble can be cleaned if necessary in preparation for the root crop in the following year. The straw of the corn crops is consumed or trodden into manure by fattening bullocks, which receive also

the portion of the root crop carted from the land, and a part of any hay which has been saved. With good average crops, half the roots are sufficient to enable the straw to be converted into manure, but if the root crop is a failure there may be a surplus of straw, and on the other hand, in an exceptionally good root year, it may not be feasible to get this proportion of roots consumed by bullocks. On the whole, however, as the rotation experiments at Rothamsted clearly show, the four-course rotation is very well balanced and enables the fertility of the land to be maintained with little expenditure on either manure or concentrated feeding stuffs. With good management and reasonable care in storing and treating the farmyard manure, the only necessary purchase from the point of view of farm fertility is phosphate, and sometimes potash for the root crop, though special circumstances may make it advisable to purchase other manures. Some small expenditure on feeding stuffs is usually necessary in order to avoid undue delay in fattening both cattle and sheep, and to secure the extra bloom and finish which often make a good deal of difference to the market price.

Modifications of the Norfolk Four-Course Rotation.—The four-course rotation in its original form is best suited for light or medium soils in a comparatively dry climate, and is thus found mainly in the east of England. It can perhaps be seen best in its original form on the Wolds of Yorkshire and Lincolnshire, though, with slight modifications, it may be found in all the eastern counties. There the climate favours the growth of wheat and barley of high quality; except on heavy soils the conditions generally are suitable for the folding of sheep; and the seeds, if left for more than one year, are liable to become thin and patchy, favouring the spread of couch.

Under other conditions it will generally be found that the original rotation has been more or less modified. Among the minor modifications, which need not be discussed at length, are such small changes as the substitution of mangolds for part of the turnips and swedes (owing to the greater susceptibility of mangolds to frost this is not done to any extent in Scotland); the substitution of oats for at least part of the wheat; the growth of an occasional crop of peas, beans or vetches in place of clover, when the latter has failed owing to drought, or when clover sickness is feared; and the fallowing of a heavy field when a wet autumn and winter have prevented any preliminary cleaning and have made it practically impossible to secure a satisfactory tilth for roots.

Five-Course Rotation.—A very common modification which requires special notice is the conversion of the Norfolk rotation into a five-year shift by the inclusion of an additional corn crop. It is difficult to improve on the four-course rotation as a means of keeping light land clean and productive, but its large proportion of roots requires a heavy expenditure on labour on all but the most easily cultivated soils, and the area of corn crops is only one-half the total arable. Although farmers, where possible, are endeavouring to open up other channels, the sale of wheat and barley is still much the most important and most dependable source of revenue available on the great majority of arable farms. It is natural therefore that on good deep soils an extra corn crop should be taken, particularly where grain of high quality and value can be grown. This not only increases the proportion of saleable crops from one-half to three-fifths, but at the same time reduces the area of roots from one-fourth to one-fifth. In such cases the second corn crop is almost always barley, and it is when so grown that the finest malting samples are secured. Not only does the previous corn crop remove any excess of nitrogen which would impair both the standing power and starchiness of the barley, but there is a good chance of obtaining a fine seed-bed and of sowing early, both extremely important factors in securing a uniform well-matured sample. The five-course rotation is thus usually: roots—barley or oats—seeds—wheat or oats—barley; but occasionally the two corn crops may be taken after the roots. This, however, is more common under the Wiltshire rotation mentioned later, where the root crop is also extended over two years and includes three or four foldings of sheep. On particularly good clean land the rotation may be extended to six years by taking two pairs of corn crops, but this is exceptional.

Rotations lengthened by leaving Seeds for two or more years.

—In Scotland, Wales, and the north and west of England, where conditions are favourable for the growth of grass, and not so suitable either for arable cultivation generally or the growth of good quality wheat and barley, the Norfolk rotation is very often lengthened considerably by sowing a mixture of grass and clover seeds suitable for two, three or more year's ley, instead of the red clover intended for one year only. The length of time for which the grass is left depends almost entirely on the rainfall. In the north-east of England, and the eastern districts of Scotland, two years is a very common period, but in the wetter western areas the period is prolonged, and in west Wales it is often eight or nine years.

Under such conditions oats are by far the most important corn crop, though some wheat and barley may be grown, more for home consumption than for sale to miller or maltster. Spring oats, which are an uncertain crop in the drier southern and eastern districts, thrive well in the wetter, cooler climate of the north and west, and they do better than either wheat or barley on soils containing a good deal of organic matter, such as the newly ploughed old leys. The straw, too, is more valued for feeding than that of wheat or barley, and the grain is not so seriously affected by a long wet harvest. In a wet climate, grasses and other pasture plants easily establish themselves, and with suitable seeds mixtures and treatment, temporary leys are more productive than any but the very best permanent grass. When they are broken up after a period of years the store of plant food which has been accumulated by the herbage is gradually liberated, and fertility is thus maintained at a low cost.

Rotations including temporary leys are of special value in stock breeding and rearing districts. A certain amount of fresh grazing becomes available every year, and pastures which may have become stale or tainted are ploughed up. Moreover, good crops of hay can be secured from the young grass, and this enables young stock to be wintered cheaply.

Another important advantage of a fairly long temporary ley is that it enables couch to be kept down at little expense. In a wet climate the eradication of couch from arable land by the ordinary cleaning methods is a matter of great difficulty. If, however, a good ley is secured, couch usually disappears after four or five years under the competition of the grassy herbage.

The seeds are almost invariably mown for hay in the first year, and may be even mown in the second year, but in that case a light dressing of farmyard manure is usually given before the second hay crop is taken. If wild white clover either grows naturally or is sown in the mixture, a good close sward is secured by the third year. Under moist conditions this will continue to give valuable grazing for a few years longer, but on dry soils, or in a rather dry climate, bent grass and other undesirable plants increase rapidly and make it desirable to plough up after the third or fourth year. Oats are almost invariably taken as the first crop after the ley.

In a wet climate the folding of sheep in winter on roots does more harm than good, except on the very lightest soils, and for this reason it is usual to cart all the roots off the land. The greater part of the crop is fed to cattle, but some may be fed to

sheep on grassland. In addition to straw and roots a considerable quantity of hay is available for cattle feeding, and a large quantity of farmyard manure is thus produced, so that the whole of the root break and some of the hay crop can be given a good dressing. The residual effect of this is sufficient to produce a good crop of corn after the roots, and to give the young seeds a good start. With this system of farming one of the main considerations in maintaining the productivity of the farm is the securing of a strong growth of white clover in the later stages of the ley. It is advisable to sow a little wild white clover in the seeds mixture, and to use phosphatic manure liberally during the rotation to give it every chance of developing. If this is done there is rarely any need to incur large expenditure on nitrogenous manure or even purchased feeding stuffs.

An additional advantage of lengthening the rotation by means of a ley is that root crops do not come more frequently than once in six or seven years, and thus the risk of finger-and-toe is reduced to a minimum, provided that care is taken to avoid re-infection through the farmyard manure, or by carting diseased roots on to a field likely to be cropped with swedes or turnips two or three years later.

In hilly districts where some fields on the farm are too steep or inaccessible for manure carting, rape is often substituted for part of the root crop. It provides excellent food for the autumn fattening of sheep, requires little labour, and the manure of the sheep consuming it takes the place of farmyard manure to a great extent. Occasionally grass and clover seeds may be sown with the rape instead of in a corn crop.

Place of Silage Crops in the Rotation.—The great development of ensilage on arable farms during the last few years makes it necessary to mention specially the place usually occupied in the rotation by silage crops. In the majority of cases ensilage is adopted in order to reduce the area of roots where climate and soil make the cost of cultivation heavy, or make the crops very uncertain. Usually, therefore, a silage crop takes the place of a root crop. On heavy land an occasional bare fallow is still part of many rotations, and in such cases silage crops may take the place of the fallow. Mixtures of winter oats, vetches and beans are mainly relied on, and are sown in the autumn preceding the year in which the root crop would normally be taken. It is important that such a mixture should be sown fairly early, so as to become

well established before the winter, and this reduces the time available for cleaning the stubble. In order to overcome this disadvantage it is customary to give a dressing of farmyard manure before sowing the crop, so as to favour strong growth which will largely suppress couch and other weeds. The crop is usually ready for cutting about July before annual weeds have shed their seed. Afterwards, the ground, if heavy, may receive a half or bastard fallow to clean it further and prepare it for wheat in early autumn; if the land is light, or for other reasons not suited for wheat, a crop of rape or even white turnips may be taken to provide sheep food in autumn. Provided that the silage crop is so treated and cultivated as to give a large weight, it is likely to be even more effective in maintaining the fertility of the farm than a root crop, as vetches or other leguminous crops form a large part of the mixture and increase the store of nitrogen in the soil. It is not so certain that the system will prove as effective as a well tilled root crop in keeping the soil clean, particularly in a wet climate, where a bastard fallow in late summer is not likely to be very effective.

Rotations including Catch Crops.—A catch crop is a quickly growing crop taken in the intervals of the ordinary rotation without seriously altering the main character of the plan of cropping. In the Norfolk four-course rotation, for instance, there is usually a long interval between the harvesting of the wheat crop and the sowing of the succeeding root crop. In an early district, the wheat may be harvested early in August, and the succeeding crop of swedes will perhaps not be sown until the following June. Where the land is clean, and of such a texture that there is no difficulty in securing a good tilth for the root crop, it is sound practice to sow as soon as possible after clearing the stubble a quickly growing crop such as rye, winter barley, winter oats, vetches, trifolium (crimson clover) or some mixture of these. Even white turnips, kale or rape may be sown in the same way. Given early sowing and good growing conditions in autumn such crops provide a considerable weight of green food which can be eaten off early enough in spring to allow of root sowing at the ordinary time.

Naturally the system is of greatest value in the south of England, where harvest is early, and root sowing is comparatively late, but even in other areas the principle may be applied in a slightly different form by sowing along with the corn crop Italian ryegrass, which is available for autumn and winter grazing, and also checks the growth of weeds and prevents the loss of nitrates from the soil in autumn and winter.

On some of the chalk soils in the south of England, notably in Wiltshire and Hampshire, the catch cropping system is developed to a great extent, and there a rotation of the following kind may be adopted. This is often described as the Wiltshire Rotation, though it is frequently modified considerably according to the exigencies of seasons and food requirements of stock. The essential feature is the inclusion of two years' root crops followed by two corn crops.

1st Year	Catch crops, <i>e.g.</i> , winter vetches, followed by late sown turnips.
2nd „	Swedes.
3rd „	Wheat.
4th „	Barley.
5th „	Catch crop, <i>e.g.</i> rye, followed by roots.
6th „	Barley.
7th „	Seeds.
8th „	Wheat.

The catch crops, and most of the roots, are eaten on the land and the seeds may also be grazed, so that the sheepfold passes over the land five or six times in the course of the eight years. On the poor light soils where this rotation is followed there is no better means of maintaining fertility.

Rotations followed in Potato Growing Districts.—Where potatoes are grown on a small scale the simplest and most common plan is to devote a part of the root area to the crop. The methods of cultivating and manuring potatoes are somewhat similar to those adopted in the case of the roots, and a small part of the root land can be devoted to potatoes without seriously affecting the rotation. Where a considerable area is to be grown it is necessary to make some modifications in the rotation as a whole. Unlike root crops, potatoes are sold off the farm, and thus do not contribute in any important measure to the supply of farmyard manure, while, at the same time, it is generally desired to give them a liberal dressing of such manure in order to secure good crops. In introducing potatoes into the rotation it is necessary therefore to make other modifications which will ensure a maintenance of the supplies of farmyard manure. In some cases as, for instance, in many districts of the north of England and Scotland, this is done by carting off practically the whole of the root crop for fattening cattle, and in effect potatoes are substituted for the proportion of the root crop which, in the original rotation, would have been eaten on the land by sheep. As much as one-half of the root break may in this way be devoted to potatoes. Where this plan

is adopted, seeds are usually left down for two or more years, so that there is generally a good supply of hay, which, consumed on the farm, enhances the value and increases the quantity of the farmyard manure, and the leaving of the seeds for two or more years adds to the general fertility of the soil.

If it is desired to have a proportion of potatoes greater than about one-tenth of the arable land it is advisable to adopt a different plan. One of the best rotations for this purpose is that followed in East Lothian and other districts of Scotland, and occasionally in England. The East Lothian Rotation is as follows: roots—barley—seeds—oats—potatoes—wheat.

This rotation allows of one-sixth of the arable area being cropped with potatoes, and at the same time provides one acre of roots to every three acres of straw. This is less than in the Norfolk four-course rotation, where there is one acre of roots to two acres of straw, and this is compensated for by carting off more than one-half the roots for cattle feeding. Moreover, in the districts where this rotation is practised good crops of roots can be secured practically every year, and there is thus rarely any difficulty in getting the straw turned into manure. This rotation is sometimes shortened by cutting out the oat crop and taking potatoes immediately after the seeds. This gives the potatoes an excellent chance, as they thrive particularly well on land containing decaying herbage, and in such cases they may be grown without farmyard manure, artificials alone being applied.

In districts where, for special reasons, it is desired to have the maximum area of potatoes, other rotations may be followed. An extreme case is the practice in coastal districts where very early crops can be secured as, for instance, in Cornwall and Ayrshire. There, early potatoes may be planted nearly every year, but it is necessary to secure from outside the means of maintaining the fertility of the land, for instance, by obtaining seaweed or town manure, though a good deal can be done by sowing or planting suitable catch crops, such as Italian ryegrass, rape, etc., after lifting the potatoes, and either ploughing in these crops or folding them off with sheep.

Dunbar Rotation.—In a limited area of East Lothian, near Dunbar, potatoes have a special value owing to their cooking quality, and the fact that they can be re-heated when cooked without loss of colour. There, the following rotation is practised: Potatoes—wheat—clover and ryegrass—potatoes—swedes and turnips—barley.

It will be noticed that from the point of view of farmyard manure this system is not well balanced, and the deficiency is made good by the purchase of town and other manure. A somewhat similar system of rotation may be followed in the neighbourhood of towns where there is a demand for straw and ryegrass hay as well as potatoes, viz., wheat—seeds or ryegrass—potatoes.

Here, everything is sold off the farm, and the fertility maintained by the purchase of town manure. Red clover could not be grown every three years, so that such a system is limited to areas where there is a ready demand for ryegrass hay or green ryegrass. In the Fen districts surrounding the Wash, there are large areas of peaty soils where farmyard manure is not required, and here a similar three-course rotation, viz., potatoes—oats—wheat, is frequently followed. Generally speaking, however, in the Fen district there is no very settled rotation. The cropping is largely regulated according to the anticipated demand and special crops of all kinds, for instance, rape seed, mustard, vegetable crops, sugar beet, may be taken if there seems likely to be a good demand, or may be grown under a contract to supply a merchant at a given price. Artificial manures are liberally applied where deemed necessary, and farmyard manure is a minor consideration on the particular type of soil, which already contains an excess of organic matter and of available nitrogen.

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AGRICULTURAL EDUCATION IN CORNWALL.

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THE passing of the Technical Instruction Act, 1891, whereby money derived from taxes on spirits was devoted to technical and manual instruction gave a great impetus to the teaching of science in Cornwall, and day and evening classes were established in many parts of the county.

Evening Classes in Agriculture.—In 1900 Dr. J. Clark, then the newly-appointed Principal of the Truro Technical Schools, conducted very successful classes in agriculture both at Truro and at Liskeard, and in 1901 similar classes were opened at four other centres—Penzance, Helston, Bodmin and Launceston. The writer acted as teacher of the five classes

outside the Truro area from their inception; for the first three years under the direction and superintendence of Dr. Clark, but from that time to the present with full control of the whole of this work in the county.

There were, of course, difficulties from the beginning, and prejudice was common. Scientific facts and theories were received with something more than doubt, and when argument failed them one could depend on hearing someone among the unconvinced express a keen desire to see the teacher "try to run a farm." Science and practice were considered to be opposed to each other, and a union of the two impossible, or, if possible, useless.

At one or two centres the classes opened promisingly with satisfactory numbers, while at some others there were so few that the question whether to continue or close down was always present. In the second year, moreover, the problem of providing single handed for both the new students and for those who had attended the first course and now required something more advanced was naturally a worrying one. The third year brought some relief—a student who had passed through an agricultural course was engaged as an assistant and the outlook became more encouraging, the attendance improved and better and more systematic work was done. There were two or three changes of assistants between this time and the year 1905, when Mr. Alex Gregg was engaged as teacher of Agricultural Chemistry, and the work became, by the help of his wider knowledge of chemistry, a more valuable aid to the farmer and student. Some impression was evidently being made by this time on the minds of the farming community, for requests for classes came in from other parts of the county and another increase of staff was necessitated by the opening of additional centres of instruction in 1906.

Progress was fairly continuous from this time onward, and when any class was closed from lack of numbers there were always two or three districts anxious to welcome the staff. In the session 1911-12 there were no less than 14 classes with something like 300 students on the registers who were being taught by four full-time and four part-time teachers. Development continued regularly until 1914-15, when there was a serious set-back which became so severe in the next session that all the classes were closed except that at Truro. Staff and students had more serious work to do, and it was not until 1918-19 that a fresh start was made with a staff of one part-time and

three full-time teachers. The number of classes and of students has not yet reached the high water mark of 1914, chiefly from lack of staff, but better work has never been done than at present, and the growth of what may be called good feeling between farmers and teaching staff has never been so evident and so real as to-day. Doubtless there are still many who scoff at the idea of men who are not "practical farmers" being able in any way to render them assistance, but they are never heard in the open, their presence is never felt at public meetings or lectures, and everywhere one finds a very genuine wish expressed for more information by means of classes, public lectures, and Press articles. Inquiries on matters of agricultural interest and difficulty arrive by post or through interviews at the rate of about ten per week in addition to the many questions which are answered at the hundred-odd public lectures given in the course of the year.

Curriculum.—From the commencement each class has, as a rule, met on one evening of the week from 6 to 9 p.m. At first this time was divided into three equal periods, one hour being devoted to each of the subjects—agricultural botany, zoology and chemistry, but when an assistant was engaged for the teaching of practical agricultural chemistry it was considered that $1\frac{1}{2}$ hours should be given to this subject and the other half to one or more of the branches of agriculture. This arrangement was found to work successfully and has continued to the present time. Students have always been encouraged to do some home-work and a fair proportion has responded every session. The home-work consists in identifying seeds in a mixture given them, in studying the notes of the lesson for the week, and in answering from three to four questions framed on the work of the preceding month. Criticisms on this home-work are made at the commencement of the agriculture lesson the following week, when the corrected papers are returned to the students.

A typical evening's work would be somewhat as follows:—

Stage I.—6.0 to 6.15, examination of agricultural plants—grasses in bundles, clovers, etc., mounted when green specimens are not procurable—with brief notes ;

6.15 to 7.15, very full notes of the lesson distributed and the lesson given, questions answered as the lesson progresses ;

7.15 to 7.30, criticism of home-work received the previous week and now returned ; questions given for coming week's home-work, with a mixed sample of seeds to be named ;

7.30 to 9.0, practical agricultural chemistry, as far as possible based on the lesson just given in the lecture-room. Usually

half-an-hour's theory followed by an hour's practical work.
One or two questions set for home-work.

Stage II (or Stage III).—6.0 to 7.30, chemistry; 7.30 to 9.0, agriculture similar to above.

In 1907 a request came from some advanced students for a course in agricultural botany, zoology, and land surveying and mensuration. A class for such men was held on one afternoon of the week at one centre, and in following years this was extended, the whole of the day being given to this more advanced work, with geology and book-keeping added to the above subjects. These courses proved attractive to the more successful students and were well patronised, but the events of 1914-15 were fatal to this as to many other forms of useful work and they have not yet been resuscitated.

Syllabus of Work.—From the first students have been encouraged to prepare for an examination. Nothing so steadies a student and keeps him up to the mark as the knowledge that there is an examination at the end of the session for which he is expected to prepare. And when a young student has successfully taken the examination of the Elementary Stage, if his ambition has been carefully nurtured he will be eager for the next fence, and will not be satisfied while there is anything ahead which he can overcome. It is in this way that students have been encouraged to attend the class year after year, and frequently the question has been put to the teacher, "Are there no other examinations we can take?"

Up to the year 1911 the syllabus of the Board of Education was followed and a great many sat for the examinations every year. This was an excellent syllabus, commencing with plant life in the Elementary Stage, going on to soils, manures, crops, stock, foods and the feeding of animals in separate sections in the Advanced Stage, and adding to a more thorough knowledge of all these, a very practical examination on a farm in the Honours Stage. When these examinations were discontinued in 1911 the writer was asked by the Examination Committee of the Union of Educational Institutions to prepare a syllabus in agriculture and the result was one on the lines of that of the Board of Education, providing a three-years' course of instruction. The work of the course is divided as follows:—

First Year.—Plant Life and Soil; *Second Year.*—Manures, Crops, Diseases and Pests; *Third Year.*—Stock, Foods, Feeding of Animals, and Farm Economics.

This has been adopted and followed in all our classes. The

majority of the students who have worked carefully and systematically through this syllabus attend for four winter sessions; they find sufficient of value and interest in the third year's work to make it worth their while to do it again. Students who have come back for the fifth year are not at all rare, but usually some variation in the work is attempted for their sakes. At two centres during the past session, 1923-4, these students have been encouraged to form themselves into discussion societies, a paper on an agricultural subject being prepared each week by the students in turn, and the reading of it followed by free discussion. This has proved quite a success and will be developed in the future, as at nearly every centre there are a few students who have passed through the course and who are yet unwilling to leave while there is anything they can study. The discussions will prove most valuable to them in many ways and their usefulness will be increased by inviting other farmers to attend and take part.

Examinations.—No compulsion of any kind has ever been exercised to induce students to sit for examinations, and the numbers taking them vary from year to year. Thus in 1913 there were 80 who sat for the examinations of the Union of Educational Institutions, and 91 in 1914. This year there were about 60 out of the 200 students in the classes. The proportion is usually about 35 per cent. of those attending, but it must be remembered that many students are not very regular, some not well educated, and also that no other county ever presents any. Before 1912 the great ambition was to take and pass the Honours Examination of the Board of Education, but the standard of the examiners in both the preliminary written examination and the practical which followed was so high that the number of those who succeeded was never very high and there were generally more failures than passes. A very fair proportion of the successes came to Cornwall and in the results of the four years, 1907-1911, we find that of the 18 who passed, 11 were students of our Classes. In 1910 a desire to qualify for N.D.A. examination was expressed by a few of the best of the students and a Day Class was held at one centre (Truro) on one day of the week for the work of preparation. The class was attended by about a dozen young men from all parts of the county and in the examination of April, 1911, we secured two or three successes. Each year after this saw the success of one or two from Cornwall until the Examination Board made an alteration in the rules which excluded practically all but

those coming from agricultural colleges. Students have also been prepared for the examinations of the Royal Horticultural Society, both the Teachers' and the General Examinations.

During the last four years competitions in the judging by points of stock, cereals and roots and the identifying and valuing of foods, manures, seeds, etc., have been held by some of our Christmas Fat Stock Societies. These have proved very popular and last year the entries at the three centres (Truro, Helston and Wadebridge) totalled 360. At the show this year of the Royal Cornwall Agricultural Association similar competitions were held for the first time, and for these there were about 100 entries.

Type of Students.—As Cornwall is a county of small-holders, 85 per cent. of the farms being less than 50 acres in extent, the sons of small farmers predominate in the classes, but though all classes are represented probably a larger percentage of the farmers with over 100 acres than of the small-holders send their sons to us. Gardeners and school teachers are also represented. The majority are from 20 to 30 years of age, with a fair proportion from 15 to 20 years, while a few from 30 to 50 years may also be found. Women are not excluded and there are frequently one or two to be seen with the men, and they are on the whole quite as successful in every way as the latter. There is now an increasing number every session who have had a year or two at the County Secondary Schools and the progress made by such students is much more rapid. The extra year or two at school has not only enabled them to retain the information gained at the elementary school but the scope of their minds has been widened by their introduction to other subjects, such as chemistry and physics. Where a youth has left school at 14 and comes into the class at 17 or 18, having done nothing educationally in the interim, the labour of teaching him is far greater than in the case of those who have never dropped their studies.

Many of the students travel long distances to attend the classes but assistance is given to those who live more than three miles from the centre, and this allowance is increased if the distance is over six miles. For the last year or two an increasing use has been made of the motor 'bus and char-a-banc in bringing students to the classes, and this will doubtless be developed in the future. The County Council pay about three-fourths of the cost, the students the remainder. It is much more economical to bring in students from distances of 12 to 15

miles to one convenient centre than it is to establish a large number of small classes with all the expense of staff, apparatus, etc.

Other Educational Activities include the giving of public lectures of which there were 100 in the session 1923-24. Very frequently the giving of one lecture is followed by a request for others and often a short course of six or eight results. The demand in this direction is beyond the power of the present staff to supply and development of this form of instruction is possible. In addition to the public lectures there is the Advisory work which continues to increase and at present fully occupies the members of the staff every morning of the week. Soils, manures and foods are tested and reported on free of cost, and questions of all kinds are dealt with.

At the agricultural college for the province—Seale-Hayne College, Newton Abbot—eight reduced-fee places are allowed to applicants from Cornwall each year, and usually there is rather keen competition for these, which is increasing as the work of the college becomes better known.

In conclusion one may, perhaps, be allowed to express pleasure and satisfaction at the end of 24 years' work—in which every member of the staff has loyally co-operated—at being able to see and feel that one's efforts have not all been in vain and that one has been privileged to assist in helping onward the work of agricultural education in one's native county. The pleasure is greatly enhanced by the abundant evidence that the agriculture staff are individually and collectively looked upon as the farmers' friends.

Dairying.—The claims of the dairy farmer to assistance by means of technical instruction were recognised as long ago as the year 1892 when travelling dairy schools were initiated. In 1898 the Secretary reported: "The travelling dairy school has visited the whole of the dairy districts of the county, and there can be little doubt that it has been of considerable benefit. . . a very considerable and beneficial change has taken place in the dairy industry of the county."

The travelling dairy schools have continued in existence to the present day, and although the dairy organiser has now the assistance of two full-time teachers, it is impossible to meet the whole of the demands for classes and courses of instruction.

During the war classes for instruction in cheese-making were first introduced, and in spite of the opinion of many so-called authorities that it was impossible to make cheese in Cornwall

the attempt proved so successful that it has been continued, greatly to the benefit of all concerned. Co-operative cheese factories have been established in several places and have proved useful in assisting to dispose of the products of the members.

The work of this department at present embraces the holding of classes for instruction in butter and cheese-making, and milking; advanced classes for instruction in the above subjects as well as in the feeding of cows, the testing of milk, and poultry management; advisory work, including visits to farms and attendance at shows in connection with competitions in butter-making, milking, etc. It is safe to say there is no branch of technical instruction which is more popular in the county than that of the dairy department, and the numerous championships and other prizes which have been won in the open classes at all the leading shows of the country afford sufficient evidence of the high standard which the work has attained.

Horticulture.—One would naturally expect that horticulture would occupy a most important position in a county possessing the equable climate which Cornwall enjoys, and accordingly the County Council, as early as 1896, appointed a horticultural instructor. Fruit plots were laid down at Penzance, Truro, St. Austell, Launceston, Penryn, Callington and Bodmin, and lectures and demonstrations were given throughout the county. For some reason, however, the interest quickly waned and the demand for demonstrations almost entirely ceased. It may have been that orchards were laid down on unsuitable sites or varieties planted which were not adapted to the climate, soil, or requirements of the county. Be that as it may, in 1905 Cornwall was without a horticultural instructor and remained without one until 1920.

In the long interval 1905-1920, during which Cornwall had no horticultural instructor the wants of the horticulturists were not entirely neglected. Courses of lectures, often accompanied by demonstrations, were given by local gardeners, some of whom were well qualified for the work. The fruit plot at Penzance (Gulval) remained in the hands of the County Council, and under the superintendence of a competent horticulturist valuable work was done, such as the production, by selection and crossing, of suitable varieties of broccoli; the manuring of potatoes to determine the most profitable amount for first earlies, &c. This plot continues to supply us with useful lessons which are of direct benefit to the people of the district, and which are also

becoming increasingly appreciated and valued by the growers around. It is hoped that in the near future an experimental fruit plot will be laid down in the eastern part of the county which will be able to deal with the local difficulties of growers in the Tamar Valley.

In 1920 a Horticultural Instructor for the county was again appointed, and from that time there has been a noteworthy development in the work of the department. Short courses of instruction in horticulture, public lectures and demonstrations have been given in all parts of the county; advice on all varieties of subjects connected with the work is being sought and given; school gardens are being inspected and, wherever possible, new ones laid out. Experiments with broccoli, potatoes, &c., are being carried out.

Last March a horticultural commercial show was held at Penzance and was a great success. The idea of such a show originated with the horticultural superintendent, and was carried out under the auspices of the County Horticulture Committee working in conjunction with a strong local committee. There were excellent exhibits of commercial spring flowers and vegetables, and demonstrations in packing and grading produce were given by experts from the Ministry of Agriculture. Papers and addresses on subjects dealing with the growing and marketing of vegetables and flowers were given, and very helpful discussions followed. The show was in every way most successful, and it is hoped that there will be developments in many directions when it is held in 1925.

Poultry.—A great deal of valuable work has been done in the county in connection with the breeding and management of poultry. As early as 1897-8 lectures were being given throughout the county under the auspices of the county council and in 1900-1901 a well-planned series of experiments was carried out at Kernock, the estate of W. Hawk, Esq.

To merely enumerate the various experiments which were carried out at Kernock, and the results which were incorporated in Mr. Hawk's Reports, would occupy some considerable space and a description of them is impossible here. Even in 1900 there were experiments with various foods—maize, white oats, wheat, buckwheat, *dari*—to determine the most profitable one for egg production. Egg-laying trials were continued through 1901 to 1905 with various breeds; the effects of free range *versus* confinement were tried in 1902-5 (with striking results in favour

of the free range); in 1902-5 a test of "*Hens versus pullets*" showed that the hen lays 47 per cent. less eggs than it did in the same time when a pullet. Trials with various foods and mixtures of foods were continued through the years 1903-1910 with valuable results; the trials on chicken feeding were commenced in 1903, and the question of which is the more profitable to produce—eggs or table fowls—was decided in the same year in favour of the egg-production with ordinary prices. The testing of pure-breds *versus* first-crosses was commenced in 1903-4; and the value of such additions to the food as rock-phosphate and sea-sand (containing a percentage of carbonate of lime) engaged attention. By this time the work had assumed such proportions and the results in many directions had become so interesting and valuable that a long report was written by Mr. Hawk for distribution in 1905. The work continued on very similar lines through 1905-10, and the results were fully described by Mr. Hawk in his "*Poultry-keeping for Profit*," which was distributed throughout the county in 1911.

In 1917 a start was made in supplying sittings of eggs and day-old chicks from two or three of the best breeds at reasonable prices. A poultry instructress was appointed in 1918 to take charge of the station, and to give advice to inquirers. This work developed rapidly, and in 1919 it was considered advisable to remove the station to Truro, this being more central. The number of incubators was increased to five and an assistant engaged to meet to a greater extent the demands for lectures on poultry management. The scheme of the Ministry of Agriculture for the supplying of eggs and day-old chicks at fixed prices from recognised good-laying strains was adopted, and each year many thousands were distributed.

In 1923 it was considered that this scheme had been at work sufficiently long to have supplied all poultry keepers with stock of high quality, and that for a time greater improvement could be effected through an egg-laying competition. The Champion Prize—a 50-guinea silver bowl—presented by the *West Briton* newspaper, went to a pen of "*Rhode Island Reds*," with 455 eggs to its credit in 182 days. The competition, with some additions, will be repeated in 1924-25.

There is at present a poultry instructor who is fully engaged the year round in visiting poultry farms and runs to give advice on the spot, in attending shows with exhibits illustrating various points in connection with the industry and in giving lectures on poultry management. During the period of the

competition—October to April—an assistant is engaged, thus leaving the Instructor free to devote his time to the duties mentioned.

* * * * *

INSURANCE AND THE FARMER.

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To the extent that the risks of farming resemble those incidental to other forms of enterprise it is probable that the existing facilities for insurance are reasonably adequate. The two great risks common to all industry are fire and employers' liability for workmen's compensation, and the farmer who elects to run them himself does so deliberately and not because of any lack of opportunity for covering them. The great tariff companies and Lloyd's underwriters are eager for business of this kind, and the main consideration affecting the farmer is not how to get protection but how to secure that he shall not pay an excessive price for it. It may be argued that farming risks of the nature indicated are less than similar ones in urban industry; the chances of loss by fire may be less amongst the scattered houses and buildings of the country-side than in crowded centres; the risks to life and limb attendant on the handling of farm live-stock and simple agricultural machinery may be less than those confronting the industrial worker; attention, too, is often directed to the high ratio of the expenses of the tariff companies to their premium income, and to the magnitude of their profits. On the other hand, it must be borne in mind that, as regards fire, the organisation for the protection of property in rural districts is much less perfect than in urban areas, and that the chances of a total loss in the case of such things as crops in stack are greater. As regards expenses and profits the case for the companies may appear to be less strong, but even here it must be remembered that what the farmer wants is security; a slightly higher premium is of less importance than the certainty of recovery in the case of loss, and the history of insurance is full of examples of ventures which have come to grief through unsound finance. It is, however, well known that many successful companies, incorporated to deal with these risks at less than the tariff rates, have been bought out by the tariff concerns so soon as their competition became formidable. There seems to be room here for combination amongst farmers for the purpose of

mutual insurance against fire and workmen's compensation risks, so as to secure for themselves the advantages (if any) of the conditions under which their industry is practised, and to retain, either by way of reduced premiums or by cash bonuses, the profits of the business.

Co-operative Fire and Employers' Liability Insurance.—

It is of interest to note that a movement in this direction was started some fifteen years ago by a group of Warwickshire agriculturists which has been attended with no little success, and which bids fair to develop, at its present rate of progress, into an enterprise of the first magnitude in the insurance world. It is a mutual society (the National Farmers' Union Mutual Insurance Society, Ltd.) financed by the issue of fixed interest-bearing debentures with no ordinary share capital, so that all the profits are available for the policy-holders after making the necessary allocations to reserves. The premium income shows a steady growth, and the expenses ratio compares favourably with that of other companies. The business is well spread between fire and employers' liability, and granted a continuation of conservative management the society should achieve its object, which is to secure to farmers the benefits of co-operation in the matter of insurance.

In passing, reference should be made to a much earlier venture in mutual assurance initiated by a group of Lincolnshire farmers some forty years ago—the Binbrook and District Farmers' Association. It started as a Glanders Insurance Association to insure its members against loss from this disease. The distinguishing feature was that it had no capital, either paid up or nominal, and that its members paid no premiums; but when a loss was incurred a levy was made upon all members, according to the acreage of their holdings, to compensate the one suffering the loss. Very few claims were made upon the association, and in 1912 it was decided to extend its operations so as to include mutual insurance against employers' liability. New rules were adopted under which membership was limited to persons approved by the Committee and occupying not less than four hundred acres of land. The occupations covered include all classes of farm labourers, blacksmiths, carpenters, machine-men, grooms and domestic servants on any member's farm, and a rate per acre is levied at the end of each year on all land to compensate members for all losses above the amount of £3, though in the case of a heavy loss provision is made for an immediate levy. If no losses are reported above the amount of

£3 no levy is made. At the present time there are thirty-nine members occupying between them about forty thousand acres. This area was fixed as the limit of the society's operations as being sufficiently large to allow the laws of average to apply without being so extensive as to necessitate any professional clerical work.

The Association has been completely successful for the purposes for which it was formed. In no year has the amount of levy equalled the amount which its members would have had to pay to an ordinary insurance company to cover their risks. Possibly its success may be due to the fact that its members are all friends farming for the most part in a large way and upon uniform lines, so that there is little variation in the nature of the risks as between member and member. Thus, the likelihood of an abnormally large loss to be spread over a very small association of persons is diminished. However this may be, the venture is an interesting departure in farmers' co-operation, and it is possible that there are other districts in which similar associations might be formed to the material advantage of their members.

Hail and Live Stock.—Following fire and employers' liability, adequate provision exists for certain other risks which are peculiar to the agricultural industry, such as damage to crops by hail, and loss by accident of valuable live stock. Most of the large companies will quote rates covering the destruction of crops, and the loss of animals through breeding risks or during transit; and here again the farmer's need is less to obtain facilities for insurance than to secure these facilities at the minimum cost to himself. This can be provided, as in the case of fire and workmen's compensation, by the formation of mutual societies or by joining those already in existence. Hail insurance is rather a special case, because the districts affected are limited, but the risk is known and if the rates are high a profit-sharing policy would secure a return of the excess to the policy-holder.

Diseases of Live Stock.—It seems, therefore, that the great question concerning farmers' insurance is not the ordinary liability to fire or accident, or the special liability attaching to valuable live stock in certain conditions, or to crops in certain districts, but the question of the protection of the ordinary live stock of the farm, both from the ordinary diseases and from

epidemics. Nothing is known statistically of the losses which farmers incur in the production of commercial live stock, but where figures have been kept, they indicate a position far more serious than many people realise. Mere insurance might hardly be expected to do much to save the industry from financial loss, but it would, of course, be a help and not infrequently a salvation to the individual; and what is of far greater importance, it would lead to the accumulation of evidence on the incidences of disease and to the organisation of treatment against it. This aspect of insurance has been given prominence by the Agricultural Tribunal of Investigation :—

“ The co-operative insurance systems abroad have resulted in much information being systematically obtained of the incidence of disease and on this account alone it would be fitting that the State should endeavour through its Department of Agriculture to advance the system of co-operative insurance. The records of mortality even in a limited number of societies would give a better indication of the loss which annually takes place amongst live stock of the country than is at present available and would provide an index of the several causes of the loss. Thus, in France, there are published each year by the Ministry, tables showing the proportion of loss among the different classes of live stock and the causes of disease. But the immediate practical object is to give the farmer a greater security against the serious loss which may at any time befall him in connection with his stock. The matter is important, particularly for the smaller farmers where the loss of a horse or a cow may be a very serious matter, whilst among farmers both small and large the incidence of an epidemic may cripple his resources for years.”*

Reference is made to the losses incurred during the recent outbreak of foot-and-mouth disease; over two hundred thousand animals of all kinds have been slaughtered and compensation amounting to nearly £3,500,000 has been paid, but this does not represent by any means the full loss to the farming community. Apart from epidemics, however, there is the question of risk from endemic disease of all kinds and from accidents, about which very little is known. At the Newcastle Show of the Royal Agricultural Society of England, in 1923, charts were exhibited, prepared by the City Veterinary Officer, Newcastle, showing the number of carcasses of animals condemned within the city during recent years, the figures for the year 1922 being as follows :—

* *Agricultural Tribunal of Investigation*, Final Report, pp. 76–77.

CARCASSES OF MEAT CONDEMNED, NEWCASTLE-UPON-TYNE, 1922.

	Total Slaughtered.	Unfit for Consumption.		Tuberculous.	
		Whole Carcass.	Parts or Organs.	Whole Carcass.	Parts or Organs.
Cows	728	38	43	39	43
Heifers	9,083	24	29	21	19
Bulls	537	3	1	3	1
Bullocks	5,986	20	27	16	14
Total	16,284	85	100	79	77
Calves	2,847	31	—	—	—
Pigs	30,281	32	—	—	—

If figures of this character could be collected from all large cities it would be possible to get a definite idea of the risk of condemnation of fat cattle which is undertaken by farmers, dealers and butchers, and to assess the premiums which would be required to cover such risks.*

Cow and Pig Clubs.—In England mutual insurance against mortality of live stock exists mainly in the form of cow clubs and pig clubs. These are by no means widespread, and they exist to cater entirely for the smallholder and the cottager, to whom the loss even of one animal may be disaster. The area of their operations is frequently no larger than a single parish, and although with good management they perform useful service it is obvious that some scheme of federation would be needed to place them on a satisfactory financial footing, combined with a very great extension of the movement if insurance in this form is to be made available to the smaller members of the agricultural community in general.† Except that this form of organisation is indigenous, however, it is probable that a better machinery could be devised to meet the needs of all classes of farmers in this matter.

Mutual Insurance Abroad.—An examination of Continental experience indicates the importance attached by other nations to the question and also the difficulties of it. In every Continental country mutual societies for live stock insurance are general, and they have been fostered and very often subsidised

* *Journal of the R.A.S.E.*, Vol. 84 (1923), pp. 282-3.

† A series of articles on Cow and Pig Clubs was contained in Vols. XXVIII and XXIX of the *Journal of the Ministry of Agriculture*, (April 1921 to March 1922 and April 1922 to March 1923).

by their Governments. It should be noted, however, that great as their progress has been in contrast with what has been attempted in this country, the great majority of agriculturists have not availed themselves of the facilities provided. In Germany it is stated that only 9 per cent. of the value of horses, 8 per cent. of that of cattle and 3 per cent. of that of pigs were insured in 1913 (Cahill); in Holland the situation is considerably better, but the local variations in the numbers of animals insured are remarkable, the Province of Drenthe, for example, having 46 per cent. of the horses and 39 per cent. of the cattle insured and Limburg having 41 and 40 per cent. respectively, whereas these respective percentages were 2 and 2.5 in South Holland and 0.7 and 1.7 in Utrecht (Leopold). In Lower Austria about 25 per cent. of the cattle of the province were insured by the Provincial Live Stock Insurance Institute in 1913 (Kallbrunner). The organisation of societies differs, too, in the various countries. In Holland they appear to be entirely unfederated, whereas in France federation and re-insurance have been carried to considerable lengths. In all countries, however, statistics show that the movement is a progressive one and a great deal of valuable actuarial data has been collected and published forming a guide to future developments. As a commercial enterprise live stock insurance does not appear attractive. In Finland four large capitalist companies engaged in this work from 1911 to 1915 had an expenditure slightly in excess of their receipts, whereas mutual local associations during the same period had an income slightly in excess of their expenditure. The explanation offered is that the costs of management in the case of the companies far exceeds that of the mutual associations. The inference is that live stock insurance is a matter peculiarly adapted to co-operative rather than to joint-stock enterprise.

The wealth of published information accessible as a guide to action is quite remarkable. From almost every European country, from Sweden to Switzerland, from France to Finland, statistics are available for the expectation of loss for different classes of stock and for the ratio of expenses to income. The figures giving the progress of the movement are themselves most impressive, and the conditions for success and the causes of failure have all been made the subject of careful study. Both in France and in Germany experience shows that local organisations of a mutual character are most suitable for live stock insurance. By them expenses of management are kept down, and in a determined district the risks are practically the same, so that

the difficulty of working out a tariff is reduced. The objection to the local society is its financial weakness, due to the limited area in which it operates and to the small number of animals covered, but this can be, and very often is met by federation and re-insurance.

It is not possible here to do more than indicate thus briefly the scope and organisation of the live stock insurance business on the Continent, but it would well repay a careful study made with the object of considering its application to this country. A start might be made through the development and federation of existing insurance clubs, for their membership is mainly confined to financially small men, and, as Cahill has pointed out, "the importance of live stock insurance for farmers may be said to be in inverse ratio to the size of their holdings." It cannot be indefinitely neglected, however, by larger farmers.

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SYSTEMATIC FEEDING OF COWS IN WILTSHIRE.

E. H. BRUCE DAVIS and G. ERNEST HUGHES.

THE following article is based on the writers' joint experiences of the feeding of dairy cows according to the system advocated by the County Agricultural Organiser for Wilts.

They were the first two farmers in the county to put into practice the advice given by the organiser in respect of feeding, and the purpose of the article is to give first hand their experience of the results.

The writers got into touch with the Agricultural Organiser owing to attending a course of lectures commenced at Warminster in November, 1922, and they were so impressed by the lecturer's remarks that he was asked to supervise personally the feeding and management of their milch cows.

Basis of the System.—The Organiser laid it down in his lectures that—

- (1) Cows should not go up in milk on going out to grass.
- (2) Heavy milking cows should not lose flesh.
- (3) Cake and meal ought not to exceed $3\frac{1}{2}$ d. per gallon at the then current prices.
- (4) A maintenance ration equivalent to 20 lb. hay should be given (*i.e.*, 0.8 lb. digestible protein and 6 lb. starch equivalent).

(5) A production ration should be fed for each gallon of milk the cow is giving (standard 0.56 lb. digestible protein and 2.25 lb. starch equivalent).

(6) The total dry matter to be 27-33 lb.

(7) The cow should be prepared for her lactation period before calving (equivalent to 2 gallon ration).

(8) Strict attention should be paid to milking and daily recording as far as practicable.

(9) Concentrated food should be used in the maintenance ration for reduction of bulk in the case of heavy milkers.

(10) Roots should be dispensed with where they have to be bought. In any case not more than 50 lb. per day should be fed, and 30 lb. for preference.

(11) Chaff should be replaced by long straw.

The writers' farms differ in character, Farm A being a mixed farm on the greensand, one-third arable and two-thirds grass, and Farm B a totally grass farm on clay, adjoining the chalk. In both cases the grass is of good average quality.

Before commencing on this system, both herds had been recorded and attempts had been made to feed in accordance with yield. Both herds are non-pedigree Shorthorns, with a few Friesian-Shorthorn Cross heifers on Farm B.

As the cows had previously gone up considerably on going out to grass, and the heavy milking cows had always lost flesh, it was felt that the system hitherto followed had not been correct. As far as cake and meal were concerned, the cost had, in the past, been somewhere in the neighbourhood of 5d. per gallon so that if the cost could be reduced to 3½d. there would be an immediate saving of 1½d. per gallon, even if no increased yield was obtained. In consideration of the above, the writers decided to give the system a trial.

Rationing System.—The system of feeding then adopted on the two farms was:—

Farm A. Hay 16 lb.
Straw (long) 4 lb.
Roots 30 lb.

Farm B. Hay 20 lb.

and, in each case, a production ration per gallon. In the case of heavy milking cows, the bulk of the maintenance ration was cut down by replacing part of the hay by half its quantity of a mixture of bran and oats, and roots were cut down in the case of Farm A to 14 lb.

Farm B, prior to this, was purchasing roots at 25s. per ton and hauling 4 miles, feeding 25 lb. per day, but these were

discontinued at once; also a certain amount of hay was chaffed, and this was discontinued.

Farm A had also been feeding chaffed straw mixed with the roots but discontinued the chaff and fed the straw long.

The production ration consisted of the following:—

<i>Farm A.</i>	Decorticated cotton cake	... 1 part	} feeding 3½ lb. per gallon.
	Rice meal and oats	... 2 parts	
	Unextracted palm kernel cake	2 parts	
<i>Farm B.</i>	Decorticated cotton	... ½ part	} feeding 3½ lb. per gallon.
	Decorticated ground nut	... ½ part	
	Rice meal	... 2 parts	
	Unextracted palm kernel cake	6 parts	

also 3½ lb. soaked coconut cake in the form of thick porridge was fed for the first gallon in the case of Farm B.

The writers consider it preferable that half of the production ration should be in the form of cake and of large pieces for preference. The reason why these particular foods were used was that they were the cheapest at the time. Heavy milking cows for every gallon over 5 and heifers for every gallon over 4 were fed with 2 lb. linseed and $\frac{3}{4}$ lb. bran per gallon.

Results.—As an immediate result, all cows increased their yields and maintained them more evenly throughout the winter; all the cows kept evenly fleshed, and at the end of the winter, cows never went out to grass looking better. Probably one of the most important factors was the preparation of the cow for her lactation period. This was done by feeding a laxative production ration for 6 weeks before calving, commencing with a 1 gallon ration at the six weeks and increasing to a 2 gallon ration at the month. This resulted in the whole of the cows coming down at calving at least a gallon higher than at any other previous period, so much so, that if a cow comes in under 5 gallons, it is an exception.

For this ration when cattle are out to grass and also when the hay on the farm is laxative palm kernel cake is used. Indoors, when the hay is not particularly laxative, 2 parts linseed cake and 1 part rice meal are given.

Milk fever is not feared as precautions are taken before the animals are calved and on neither farm has there been a case of milk fever.

At the commencement of the system, daily recording was practised to see the effect of the rations on the individual cows and to increase the food to those increasing in yield. This also enabled the writers to keep a check on their milkers.

On going out to grass, Farm A had a slightly increased milk yield—about 7 per cent.—but Farm B had a decreased yield of about 6 per cent., part of which was later recovered. In both cases cows were turned out to plenty of grass about the beginning of May.

At the end of the year, Farm A had an increased average of 50 gallons per cow and Farm B of 120 gallons per cow; in the former case the herd had been recorded for many years, whereas the latter was newly formed and had only been recorded for three years. On Farm A it is estimated that the decrease on the cake and meal bill, after making an allowance for difference in prices, was over £150 during the year.

Modification and Results in the Second Year.—After the experience of 1922-25, the writers were absolutely convinced of the effectiveness of the system, and preparations were made for the following winter by forward buying of feeding stuffs in collaboration with the organiser. During the last winter, more attention has been paid to dry matter by the cutting down of bulk of the maintenance ration, and in all cases the cows have been prepared for their lactations, this latter point being one that is most important. 'This preliminary feeding before calving is even more necessary for heifers than for cows, as is proved by the heifers in these two herds.

Also in the case of Farm A roots have been reduced to 14 lb. per day, although there were sufficient on the farm to have fed 70 lb. per day.

With one winter's experience behind them and the men being more accustomed to the work and at last being converted, the results have been even better than the previous winter—to be precise, the daily average has been increased $\frac{1}{2}$ gallon per cow.

On Farm A, the average number of cows (including dry cows and 17 heifers) was 75, and the average daily yield during the winter was 200 gallons. On Farm B, the average number of cows (including dry cows and 19 heifers) was 60; the average daily yield during the winter, 170 gallons. The ration for the last winter, owing to forward buying, cost 3d. per gallon. At the present moment (at the end of 7 months) there are in herd B as many 1,000-gallon cows as there were in the preceding 12 months.

Experiments have been conducted on three times milking on part of the herds, the result being $\frac{1}{2}$ gal. increase per cow and 75 per cent. of cows responding. The effect was most marked on the heifers, some of which increased up to 1 gallon per day.

At the time of writing, Herd A has gone out to grass, and at the end of three weeks the yield is down 5 gallons per day. Herd B has only been out to grass three days, and the three times milked cows have shown a slight increase; these latter cows are kept in from 1 p.m. to 8.30 p.m., and have their cake ration for gallons over three during that period.

The system of summer feeding is :—a value is put to the grass (at present, 20th May, 3 gallons) and a balanced production ration fed for each gallon over three. The feeding value attached to the grass is altered as the season advances. A small quantity of cotton cake is fed to prevent cows being too laxative. In the fall of the year, the grass will be balanced up to 3 gallons by a concentrated cake.

From the writers' experience of this system of feeding, they are absolutely convinced of the efficiency of the system and are very grateful to the organiser for his advice. They are certain that every dairy farmer will be well repaid for any attempt he may make to follow the system.

The writers would like to emphasise the fact that from their experience it is not a question solely of feeding a balanced ration according to yield, but it is by attention to minor details of management that the best results are obtained. As far as their experience is concerned, they are convinced that the feeding of chaff is detrimental, the heavy feeding of roots is not economical or desirable, and the order of feeding the various fodders and concentrates is of material importance. The importance of the order of feeding is to prevent, as far as possible, the animal overfilling herself, as one of the essential factors in the Organiser's instructions is that the cow must not be overfilled. To get over this, the cake and meal is always fed before the bulky food, as, if this is done in the opposite order, the cow, being hungry, will eat a large bulk of hay and then consume cake and meal afterwards because she likes it, resulting in overfilling and a grunting cow; also, for heavy milking cows, three times a day feeding of concentrates is practised. The order, then, is as follows :—

5.30 a.m., $\frac{1}{3}$ rd cake and meal.

7 a.m., hay.

1 o'clock, $\frac{1}{3}$ rd cake and meal, followed by hay.

6 p.m., $\frac{1}{3}$ rd cake and meal followed by hay.

Watering three times a day, the last watering being at 8 o'clock at night.

The value of watering at 8 o'clock at night cannot be over-estimated.

Although the writers were the first farmers in Wiltshire to commence this system, it is common knowledge that a large number of farmers are now doing the same with similar beneficial results, and in some cases with even better results than their own.

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CORNISH MARL EXTRA-LATE-FLOWERING RED CLOVER.

BASIL JENKINS, B.Sc.,

Cornwall County Agricultural Staff.

THE red clover crop plays an important part in grassland improvement, but good seed of the proper strain is essential in order that crops may be uniformly productive over the whole duration of the pasture. In south-west England, where leys are left down for three years or more, the farmer complains that broad red clover seed does not give a lasting plant: in the first year a good crop is obtained, in the second harvest year much less, and in the third year only a few straggling plants. One of the chief reasons for the poor crops of red clover is the use of foreign seed from warmer climates, even though it is of better appearance and higher germination through not having been subjected to the adverse weather conditions which cause many British-grown samples to be shrunken and of a dull colour.

The clover trials conducted by Professor Stapledon at the Welsh Plant Breeding Station, Aberystwyth, however, have conclusively proved that British seed from a high-lying district with a cool climate is to be preferred to foreign samples, though the same high germination is not to be expected. The strain of the plant is more important than superlative germination.

A somewhat localised area on the wind-swept uplands of the north-west coast of Cornwall, around Wadebridge, has for many generations been famed for the persistence of the clover grown there. This gives good bulk throughout the whole three or four years of the customary duration of the leys; crops have been known to last ten years, and plants for longer periods. As red clovers of all nationalities are mixtures of highly variable natural hybrids resulting from cross pollination, it is remarkable that the strain has retained its purity for so long, and this can only be accounted for (1) by its isolated position, (2) by the fact that little late-flowering red clover from other districts is sown in Cornwall, and (3) by the fact that the growers invariably grow their own seeds in a manner that has brought about a continuous mass selection.

In preliminary clover trials with early- and late-flowering types of red clover, Cornish Marl clover has shown itself to be more persistent than any other strain of clover except Montgomeryshire Red—a strain grown in Wales which is very similar to that grown in Cornwall. The following data* show that it is capable of great winter hardiness and of giving high yields over a number of years.

Table I. Relative Yields of different Strains of Red Clover Compared with English Late-Flowering Clover expressed as 100.

Strain.	1921.		1922.		1923.	
	1st Harvest year.		2nd Harvest year.		3rd Harvest year.	
<i>Lates.</i>						
English Late-Flowering	...	100	...	100	...	100
Cornish Marl	...	109.5	...	103	...	134
<i>Earlies.</i>						
Broad Red	...	107.2	...	55.6	...	39.8
Chilian	...	82.5	...	24.6	...	34.1
Italian	...	37.2	...	0	...	0

Its extensive root system, which penetrates to considerable depths, appears to give it a greater power of resisting drought than the Welsh strain, and in a season like 1923 it also showed itself capable on a light soil of giving a higher yield in the first harvest year than any other early or late strain.

The use of disease-resisting strains for all crops is becoming of increasing importance in controlling fungus pests, which tend to lower the clover returns considerably. In this connection it is interesting to note that there appears to be no other form of red clover so resistant to the attacks of *Gloeosporium caulivorum*, which has recently caused havoc amongst the clover crops on the Continent and in E. England, Italian clover being particularly susceptible to this disease.

Table II. Relative Susceptibility to Anthracnose of the different Nationalities of Red Clover.†

(The highest mark represents the greatest susceptibility.)

(The highest mark represents the greatest susceptibility.)					
Nationality.	1920.			1921.	
		No. of Lots averaged.	Average Marks.	No. of Lots averaged.	Average Marks.
<i>Late-Flowering Group.</i>					
Cornish Marl	...	3	0.3	...	2
Montgomery	...	2	1.5	...	6
English Late	...	31	1.0	...	2
<i>Early-Flowering Group.</i>					
Italian	...	5	4.0	...	2
English Broad	...	39	3.0	...	1

* See Williams, R. D. Investigations with Herbage Plants at Welsh Plant Breeding Station.

† Preliminary Investigations with Herbage Plants at the Welsh Plant Breeding Station, Aberystwyth.

Trials with Cornish Marl clover are at present being conducted on clover-sick land in the eastern counties of England.

The Cornish soils are notably sour, and locally the clover has a reputation for persisting on such soils. Samples of soil growing good crops of Cornish Marl have been tested at the county laboratory and tend to substantiate this belief.

Cornish Marl is an extra-late-flowering strain of red clover, flowering about two weeks later than English late and three weeks later than broad red. It tillers very freely, and has a dense tufted habit. More stems are produced than in any other strain except the Montgomery red, and more side branches are produced, especially towards the top of the stem. It gives a very heavy single hay crop, but the aftermath is poor (with only an occasional plant in flower) unless the hay has been cut early, and there is little growth during the winter and early spring. Its outstanding qualification is its ability to persist for a longer time than any other kind of red clover except Montgomery red. Either might be used with advantage for three years or longer duration leys, whether hay or grazing be the object in view.

The plants and seeds of all red clovers are so much alike that the average farmer is unable to distinguish between them, and local seed merchants are not more successful with their seed. Many mixed samples are offered and disappointing results obtained. After two seasons' growth there is no difficulty in telling which has been sown, but unfortunately this knowledge will not help the farmer in purchasing his seed. Cornish Marl clover seed is smaller and not so bright as broad red; more seeds are provided per pound, but until the present year the seed was so unclean that it could not be regarded as a commercial proposition.

In March of this year a conference of all the principal growers at St. Columb decided to form a Cornish Marl Clover Growers' Association.* The objects are to guarantee the origin of the seed and retain the purity of the strain; to secure and provide for earlier threshing and cleaning operations so that the seed may be ready for market at the beginning of the season; to afford facilities for the testing of the seed under the Seeds Act, 1920, samples being forwarded to the Official Seed Testing Station, Cambridge; and to organise the marketing and advertising of the seed.

The co-operation of the local seed merchants has been obtained, and they have been allowed to become members on the condition

* The Secretary of the Cornish Marl Clover Growers' Association is T. Rowse Hosking, Town Mills, St. Columb, Cornwall.

that they only sell seed as Cornish Marl which has been grown by members of the Association.

It is intended to issue guarantee certificates to growers of the pure strain, and the writer, at the request of the Association, has assisted in inspecting the clover crops, in connection with the carrying out of his duties under the County Council. The growers of the pure strain are thus known, though the Association itself does not propose to issue guarantee certificates until the third year.

In order to maintain or even improve the persistency of the strain it is intended to obtain seed for seed purposes only from old leys, or those which have been down for at least three years, to be distributed to other seed growers, at slightly enhanced prices, for the extra trouble involved. Later on, the Association intends to register the stocks on the same lines as pedigree live stock societies.

Clover trials are being conducted at the Cornwall County Council plot with about twenty different nationalities of clover to compare their relative persistency and yield with the local seed under local conditions, with a view to selecting the best strains of Cornish Marl for seed-growing purposes.

The amount of seed available will vary with the climatic conditions prevailing in the west, but the increased acreage sown this year will aid in equalising supply and demand, which it is anticipated will increase as the Cornish Marl Extra-Late-Flowering Red Clover becomes more widely known. Less valuable clovers are being imported; our home-produced article could replace these and be of benefit to the grower and consumer alike.

* * * * *

THE COUNTRY WHEELWRIGHT AND HIS OUTLOOK.

CONTRIBUTED BY THE RURAL INDUSTRIES INTELLIGENCE BUREAU.

History and Present Condition of the Trade.—For a long period, certainly since mediæval times, the wainwright or wheelwright has occupied an assured and outstanding place in the scheme of rural life. He was the maker of carts and wagons, and various other vehicles and implements used in agriculture and constructed chiefly of wood.

Coach and carriage building was, in this country at all events, a comparatively recent refinement of the craft, which started at

the latter end of the 16th century, and expanded to the dimensions of an industry only in the middle of the 18th century. To this branch of the trade the village wheelwright seldom or never aspired. On a higher plane as regards constructional skill, knowledge and special aptitude required, and for long a luxury trade rather than an essential industry, coach building naturally became an urban undertaking, and probably from the very first always tended to attract and absorb the more skilful, intelligent and progressive men. Businesses of this type were undoubtedly the forerunners or formed the nuclei of the extensive present-day vehicle building industry, which has been able to adapt itself in turn to the production of the stage coach, the hackney carriage, the railway carriage, and finally the motor car.

In the remoter rural districts, change has been slow to affect the wheelwright and slower still to be appreciated. Down to a generation or so ago, he continued to produce the article he and his little circle of customers were used to, and to employ the methods which had sufficed for his fathers before him. In recent years the decline of local industries has been more rapid, and at the present time the great majority of farm vehicles produced are factory made. Large numbers of carts and wagons of the old type are still in use after repeated patchings, and a certain proportion of farmers make a practice of ordering the hand-made vehicles, which they consider more reliable and more lasting. But these are the exception, and generally speaking, the country wheelwright's trade has reached a stage of depression beyond which its further existence is seriously threatened, if not rendered wholly impossible.

The Use of Motor Transport.—Various causes have contributed to this state of things. The rise and rapid development of the motor industry has certainly lessened to some extent the demand for horse-drawn vehicles in agriculture, and consequently for the wheelwright's services. The farmer's gig or trap has been largely replaced by the cheap car and, since the War at all events, his produce goes to market or to the railway station more frequently by lorry than by wagon. The horse-drawn vehicle has tended to become more and more restricted to the area of the farm itself, with the result that not only are fewer required, but those few are not so constantly used, and need replacement and repair less often.

Prospects of a Revival in the Demand for Horse Vehicles.—There are some signs, however, that the present wide preva-

lence of the use of motor vehicles is more of a temporary phase than a settled tendency on the part of agriculturists. It appears to have been overdone in several directions to the detriment of both economy and efficiency. At the conclusion of the War, agriculture had had several very prosperous years, second-hand Army lorries were abundant and cheap, and hope in progressive methods ran high. Since then, years of depression have come, and the source of supply of these vehicles has all but dried up. Their short life and high cost of upkeep, especially towards the end, to say nothing of the annual tax of £25, which has to be paid on vehicles of two tons or over, has so disillusioned many who invested in them, that they are little likely, even if they could afford it, to replace worn-out lorries with new ones costing £600 or £700 each. Though the motor vehicle in agriculture, in one form and another, has come to stay, and the demand for farm vehicles of the old type is unlikely to reach the old proportions, yet it may be expected to increase during the next year or two, and if at the same time agricultural conditions improve generally, it should again assume decidedly healthy dimensions. Signs are not wanting indeed that it has already begun. Many country wheelwrights may have noticed—one or two indeed have commented on it—that at sales of stock and implements, second-hand carts and wagons, some of them 30 or 40 years old, are eagerly bought up by farmers, fetching, often enough, prices which the wheelwright would be glad to get for a new one to-day. This suggests that a latent demand exists, waiting for those able to take advantage of it. The bulk of this work must be expected to go to the bigger manufacturers. But it seems very possible that as things now are, it might be worth while, for a country wheelwright who could afford it, in the intervals of his regular work, to build one or two carts or a wagon as a speculation without waiting for an order. The old skill has not yet died out, and when the vehicles have been built, a little wider and more favourable market than the nearest farmers provide might be reached by putting a small advertisement in some periodical connected with farming interests.

This is advertising in its most elementary form, and advertising must be an essential feature of any business which nowadays intends to manufacture goods for sale. Newspaper advertisements should be accompanied, wherever possible, by exhibits of carts and wagons at local agricultural shows. Those firms who do exhibit, have usually in our experience, found it

profitable in bringing them orders. Most customers naturally like to see what they are buying before they buy, and the county agricultural show provides a useful shop window at no great expense. Besides providing the nucleus of a rather wider market, freeing the worker from dependence on one or two local customers, such an experiment should show him clearly the very great advantage of being able to supply goods more or less ex-stock, instead of continuing the present indefinite delay in delivery, the result of waiting for an order before starting work. The inconvenience of this delay is a heavy handicap. It is enough by itself to keep potential customers away unless they can get absurdly low prices or long credit as a set off.

The Credit Question.—The long credit required by farmers is often said to be one of the chief causes of the collapse of the wheelwright's trade. No doubt circumstances have combined during the last few years to accentuate this old standing feature of the relations between the wheelwright and his principal customer. The long credit—6 to 12 months—appears to have been customary at least beyond all living memory, and any intensification of hardship from this source must be chiefly laid to the account of prevailing agricultural depression. It is decidedly contrary to present-day business methods, and the only way of getting rid of it is by effective organisation among wheelwrights themselves.

Ignorance of Business Methods and Undercutting.—In the inquiries which the Bureau has made, particular attention was directed to the business methods of country tradesmen, and it is clear from the information obtained that quite a large proportion of the master men in the rural areas, have little idea of what constitutes profit or loss on a job. Many seem to be quite contented if only they can get work to do, and to achieve that end are ready to undertake it at prices often enough bearing no relation to actual cost of production.

The worst effect of a blind readiness to cut prices is, of course, that during any prolonged period of depression and work shortage, it compels the many who know better to follow suit. In busy times the matter is of no importance. The output of those who habitually practise it would be very small and uncertain; the owner of such a business could seldom afford to employ journeymen, his own earnings being usually below the rates they would demand.

The Overhead Charges of the Factory and the Small Firm.—

We have come across not a few wheelwrights who seem to be quite convinced that on account of very much lower overhead charges, the country shop can profitably build its carts and wagons in the old-fashioned way, at a price which will compete with the mass product of the factory. This is a point which is worth a little general consideration, and the wheelwright who proposes to manufacture should take careful account of it.

The overhead charges of the factory amount in the aggregate to a considerable sum, but, spread over the greater number of productive workers employed, they become reduced to quite manageable proportions. In a normally busy and efficiently conducted business of the sort they should not exceed 120 per cent. of the average labour cost, let us say, for example, 2s. per workman per hour.

The charges on a small country business are more difficult to arrive at, and in too many cases it is to be feared the owner concerns himself far less with the matter than he should. Whether realised or not, they are still there, and in the long run, if neglected, they are liable to make themselves unpleasantly conspicuous.

In a small country shop run by, say, its owner and one assistant, occupying premises of reasonable size and convenience for this type of trade, the following must be regarded as overhead charges—rent, rates and taxes, light, fuel, interest on capital locked up in stores and stocks of material, insurances, depreciation, allowances for replacements and repairs, non-chargeable time, bad debts, carriage costs and general business expenses. They would amount to at least £3 10s. per week, and if in addition there were a power-driven saw or other machine installed, decidedly more—probably about £4 per week. Of the above items, the cost of “non-chargeable time” will be one of the heaviest and the least often considered.

This £4 per week has to be spread over the chargeable working hours, *i.e.*, those for which the owner and his assistant are being paid by the customer for work done. In this connection, if the assistant is not a skilled hand, his time should not strictly speaking bear as full a proportion of the overhead cost as the employer's: he may be in fact partly an overhead charge himself. We may assume, however, that the owner and his assistant work 80 chargeable hours per week between them. Overhead charges are therefore 1s. per workman hour and rates

of earnings being commonly below those obtaining in urban industry, this may very likely represent 100 per cent. on labour.

We can safely say that, owing to mass-production methods and labour-saving devices, a manufacturing job occupying 100 workman hours in the factory, requires 200 in the country shop without machinery. As we are supposing, however, that the latter has a power-saw, we will reduce this to 170.

Let us now compare these estimates :—

<i>Factory.</i>			<i>Country Shop.</i>		
	£	s. d.		£	s. d.
100 Hrs.—labour at average			170 Hrs. labour at average		
cost of 1s. 6d., say ...	7	10 0	cost of 1s.	8	10 0
100 Hrs. on costs at 2s. ...	10	0 0	170 Hrs. on cost at 1s. ...	8	10 0
	<u>£17</u>	<u>10 0</u>		<u>£17</u>	<u>0 0</u>

In this hypothetical case, which we can imagine represents the cost of production of, say, a farm cart, the country shop has a few shillings advantage over the factory, an advantage, by the way, due rather to lower wages than to lower costs. This sum has to be used to offset the larger manufacturers' advantage in wholesale buying of materials, to provide any margin for price competition, and also for the larger profit per vehicle required by the small man. The margin is obviously totally inadequate for underselling the factory.

The position outlined above can be improved within limits if there is sufficient work going to warrant the employment of more workers to spread the charges over. Overhead costs, however, have an unpleasant habit of increasing rather rapidly in a small business. For instance, in this case two more workers would apparently double its size, but the owner himself would become more of a supervisor and less of a producer, and a larger proportion of the cost of his time would become an overhead charge. Employees demand higher wages than the working owner often expects to earn himself, and it is clear that additional assistance, if it is to bear its proper share in reducing these costs, must be of the skilled productive order. To engage extra labourers or boys would merely add to them.

It is easy to account for the prevalence of a too favourable view as to the overhead charges of a country shop. It results from confusing the conditions which govern repair work with those of manufacture. There are seldom any mass-production ways of doing repairs, and the country wheelwright in this branch can compete very nearly on level terms as to working time and methods of doing the job. The factory may perhaps

have spare parts available, but this is no overwhelming advantage, and spares are usually charged for at a good deal higher rate than when they form components of a complete new article. In repair work, therefore, it is quite right to assume that his lower costs of working will give him a decided pull over the bigger business, but to apply the same reasoning to the production of new goods for sale is altogether wrong.

Importance of Proper Costing.—The undercutting done by some small businesses, to which we have referred above, is due not so much to low costs as to the fact that no proper accounts and costs records are kept. A system of book-keeping and costing, however simple, is essential. Without it, it is impossible to manage a business efficiently, or to compete intelligently with others. The lack of it is the cause of most financial disasters.

Note.—Two pamphlets issued by the Bureau deal with book-keeping and costings in a simple and elementary form, designed specially to meet the needs of the small business. The wheelwright is advised to study them and use the methods recommended to ascertain in his own case how he stands on different jobs, and whether the prices which he gets return him actually a profit or a loss.

The Quality of the Vehicle.—Another point often put forward is that the country wheelwrighting shops can and do turn out vehicles superior to the factory product. If this were so, one would not have expected them to have lost the farmer's custom to so large an extent as they appear to have done, as they are admittedly prepared to cut prices to a sufficiently fine degree. As a matter of fact, though there are exceptions, it is nowadays far from being generally or even usually true; one of the most important parts, if not the most important, of the cart or wagon, and that on which the greatest care and skill used to be expended, was the wheel, and it is common to find that the country worker nowadays buys his wheels ready made from the factory. It is true, however, that the class of vehicle produced in the country shops a generation or two ago was better value for money than the factory made article is to-day.

Repair Work and Side-Lines.—So far we have considered the country wheelwright solely as a maker of farm vehicles of various types, but it is quite common to find him more or less of a general purpose village woodworker as well.

Even in its palmy days the wheelwright's business by no means always concerned itself exclusively with building and repairing agricultural vehicles. It was frequently, also, the general local woodworking shop, just as the smithy, apart from farriery, was the local shop for work in iron. Of late years,

owing to the decay of vehicle building, many of the men have had to develop other lines of activity to a much greater extent than formerly. In some parts of the country, there are even now special lines of work reckoned to belong to the wheelwright, such as coffin making, hurdle making, etc., while it is fairly general to find at any rate the smaller businesses regularly turning to fencing, repairs to gates and farm buildings, and all the general jobbing work embraced in the term estate carpentry. Others again, where the opportunity presents itself, have turned in the direction of the building trade and taken up house carpentry and joinery, as a more remunerative occupation.

These developments may be considered retrograde, in the sense that such work is less skilled than the manufacture of wagons. Although repair work may pay better for a time, the capacity to repair will be lost in the end by those who have no experience in building the vehicles themselves, with the result that the loss of the repair work itself may be finally anticipated. But the changes are inevitable here and there, especially in the case of a business on a very small scale where the owner's financial resources and credit are too low to tide him over periods of depression, or to enable him to adopt the suggestion made above as to making a few vehicles for stock. Such a man should study still more than he has done in the past, the newer needs and possibilities of his own neighbourhood outside his specialised craft and try in all possible ways to adapt himself to them. At the same time, it is to be expected that this process, the stages in which are alluded to above, will lead in the next generation to the complete submergence of the wheelwright into the jobbing carpenter.

In regard to side-lines, several of the Bureau's publications dealing with woodworking trades, may provide useful ideas suited to individual cases. Particulars can be obtained on application to the Bureau, 258-262, Westminster Bridge Road, London, S.E.1.

Machinery.—The question as to whether it is advisable to instal power-driven woodworking machinery is important, and in these days it is certain that for the would-be cart and wagon builder to do without it altogether, is in nine cases out of ten a great mistake. It requires, however, careful consideration on the part of the individual concerned. A great many country shops, perhaps the majority, make no use of it, some because they cannot afford it, some because the amount of work ob-

tained would not in their opinion warrant it, others again, from mere disinclination to new-fangled ideas. In a small country business the amount of machinery put in can very easily be overdone, and the potential output of the shop increased beyond the local requirements. Generally speaking, however, the small man will find that the possession of some up-to-date labour-saving device has a beneficial effect not only on his business, but on his outlook and methods out of all proportion to the actual amount of time it saves. It enables him to undertake jobs he never thought of doing before, and intelligently used and exploited, it helps to stimulate and educate the local demand for his services.

Wheelwrights who also carry on a blacksmithing business might find information of interest and value in the Bureau's pamphlet No. 4, and would be particularly advised to consider whether it would not be of value to use acetylene welding apparatus. More than one country worker in this category has stated that its installation has been very helpful to him and brought a large volume of extra work, so that he could not now possibly do without it.

The Necessity of Organisation.—A yet more important and pressing matter than new branches of work, new methods of business and modern equipment or machinery, is a new policy of organisation, combination and education. The country craftsman needs to take an interest in the welfare of the industry at large, to keep less aloof from others engaged in it, to regard them less as enemies to be undercut if possible and more as potential colleagues available for mutual help and protection. Very few seem to be members of any Trade Association and the majority are apt rather too readily to assume that such associations exist to advance the interests of urban industry to their own detriment. But the attitude of mutual distrust among village tradesmen is helping to ruin their trade and must be dropped.

There is already in existence an Association of Vehicle Builders, and in this organisation there should be found a body which could, if its membership included an influential proportion of country wheelwrights, do much to remove the apprehension that the next generation will see the small men largely swept out of existence. Unless some action along these lines is taken, the fear is but too likely to prove well grounded.

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THE NATIONAL POULTRY INSTITUTE.

THE following statement was made by Mr. P. A. Francis, the Ministry's Poultry Commissioner, at a meeting of the National Poultry Parliament at Salisbury, on Wednesday, 16th July, 1924 :—

All the arrangements for commencing work in five of the six sections provided for under the National Poultry Institute Scheme are now completed. It will be remembered that the original scheme, the general plan of which has not been altered, aimed at the provision of centres as follows :—(1) a new centre for higher instruction and commercial experiments in poultry husbandry, to be located at Harper Adams Agricultural College, Newport, Salop; (2) scientific research in problems of poultry breeding, at the School of Agriculture, Cambridge; (3) scientific research in problems of poultry nutrition, at the School of Agriculture, Cambridge; (4) scientific research in poultry diseases, at the Ministry's Veterinary Laboratory; (5) practical experiments in the North of England in the breeding of poultry for egg production, and (6) practical breeding experiments in the South of England in table poultry production. Active work is now proceeding in all these sections except the proposed new educational centre at Harper Adams College.

As regards the Harper Adams College part of the scheme, the first step will be to secure the services of a Director possessing the requisite technical and academic qualifications and experience to take charge of the work under the Principal of the College. The Governors of the College have been authorised to invite applications for this post, and it is understood that, in response to announcements widely advertised in the poultry press and elsewhere, a considerable number of applications have been received. These are now being considered by the Governors, who will be responsible for making the actual appointment, subject to confirmation by the Ministry after consulting the National Poultry Institute Advisory Committee. As soon as practicable after the new Director has taken up his duties, detailed proposals, with estimates, will be drawn up for the commencement of work under this part of the Scheme.

Breeding Research.—The new buildings for research in problems of breeding (*i.e.* a laboratory and cottage) are now completed, except that the laboratory has not yet been equipped with the necessary fittings. A beginning has, however, been made with the actual breeding investigations, a programme having

been drawn up for a series of experiments designed to throw light upon the inheritance of fecundity, which is regarded as the main line of investigation. From the very nature of the work, at least two and a half years more must elapse before even a preliminary report can be framed, for even this cannot be done without the evidence afforded by three successive generations of birds.

Nutrition Research.—As regards research work in problems of poultry nutrition, the necessary poultry buildings, etc., have been erected at Cambridge and are now being used. The following is an outline of the programme of research at present being carried out:—

Partition of Nitrogen of Urinary and Fæcal Origin.—Dr. E. H. Woodman has already evolved a satisfactory method for the quantitative estimation of uric acid in poultry excreta. It is hoped that information will be obtained from this method which will enable the investigators to invoke the chemical method of separation of the urinary and fæcal nitrogenous constituents from the excreta of normal birds. The methods already in use are not considered reliable.

Digestibility.—Digestibility determinations of Sussex ground oats and maize meal have been undertaken with four White Leghorn cockerels. Complete results will not be available until the matter referred to in the preceding paragraph has been settled. Preliminary figures so far obtained show close approximation to Kaupp's and Ivey's digestibility co-efficients, and indicate that the digestibility of the fibre of oats is little affected by grinding.

Future Digestibility Determinations.—In the immediate future it is intended to determine the digestibility of (1) the oats from which the Sussex ground oats already used for experiments were made, (2) the maize from which the maize meal already used for experiments was made, and (3) two strong wheats (Yeoman and Durum) and two weak wheats (Swedish Iron and Rivett). The determination of the digestibility values of weak and strong wheats is considered to be of immediate economic importance.

Mineral Balance Experiments.—An attempt has been made to ascertain the calcium, sulphur, nitrogen, phosphorus and energy balance of pullets before and during egg laying. Two White Leghorn pullets have been used for this experiment, and the material necessary for the determination of these balances has been collected over a period of 14 weeks. The analytical

work involved is heavy, and several months must elapse before the results can be collated.

Comparative Slaughter Experiment.—200 White Leghorn eggs have been incubated to form material for slaughter and analysis at different ages from the egg to maturity. Samples have already been prepared and bottled for analysis as follows: (1) new laid eggs, (2) 14th day incubation, (3) "pipping" stage of hatching, (4) 7-day-old chicks, (5) 3-weeks-old chicks. Further material will be collected at intervals of one month.

Method of Absorption of Yolk Sac Material.—100 White Leghorn eggs have been incubated in order to trace as far as possible the nature of the changes undergone by the yolk sac and its contents from the 10th day of incubation onwards, and its relationship to the alimentary canal. The following facts have been elicited. (1) At no time is there any tubular connection between the yolk sac and the interior of the gut. (2) The intestines, which lie outside the body in the earlier stages of incubation, are drawn into the body on the 19th day and not on the 15th as stated by some scientists. (3) The yolk sac is drawn into the body cavity during the 20th day of incubation.

Disease Research.—The new buildings and equipment for research work in poultry diseases at the Ministry's Veterinary Laboratory have been completed and are now ready for use. Actual research work in connection with poultry diseases has been carried on in the main laboratory for over two years, and a very large amount of post-mortem work has also been done for poultry owners. Some of the diseases on which research work has been begun are: Fowl Cholera, Fowl Typhoid, Bacillary White Diarrhoea, Fowl Plague, Tuberculosis, Avian Diphtheria, Bird Pox, Coccidiosis and Blackhead.

The progress of the research work has recently been delayed owing to the officer who was primarily in charge of it having left to take up another appointment elsewhere. The services of a suitable officer to take his place have, however, been obtained, and the work will now proceed on methodical lines.

Northern Breeding Experiments.—A special Sub-Committee of the National Poultry Institute Advisory Committee has been appointed to deal with the Northern Experiments in breeding poultry for egg production. It is at present constituted as follows: Professor S. J. Hickson, D.Sc., F.R.S., Chairman (nominated by the Ministry); Messrs. J. Edmondson, W. Sutton, J. Wrennall, C. Longbottom, G. R. Poole (nominated by the National Poultry Council); Principal W. B. Mercer, of the Rease-

heath School of Agriculture (nominated by the Ministry); Messrs. F. Snowden and D. C. Hesketh (co-opted by the Sub-Committee); and Mr. W. Thompson (nominated by the National Poultry Council in place of Mr. Hammett, appointed a member of the Main Committee); with Mr. F. Glover, of the Ministry, as Secretary.

The Sub-Committee held its first meeting on 4th September last, and at once proceeded to draw up its scheme of experiments, which is as follows :—

- (1) To test experimentally the effect of inbreeding with certain selected strains of fowls, by mating together brother and sister, dam and son, sire and daughter, dam and grandson, etc., the relative fecundity of the matings to be carefully recorded.
- (2) To test the effect of out-breeding on fecundity in certain selected strains of fowls.
- (3) Concurrently with (1) and (2), to make observations on the strains employed in order to obtain evidence on the question whether there is, or is not, a linkage between external characters and fecundity.
- (4) Concurrently with (1) and (2) to record any data bearing on the possibility of building up a strain of pullet breeders.

The Sub-Committee sent its scheme of experiments to the County Councils of Lancashire and Cheshire with a suggestion that facilities for the experiments might be provided either at the Lancashire County Farm at Hutton, or at the Cheshire School of Agriculture, Reaseheath. Both Councils offered facilities readily on certain conditions, and after consideration the Sub-Committee recommended that the offer of the Cheshire County Council should be accepted. A very suitable site at Reaseheath, on old turf over well-drained soil, easily accessible from a main road, was accordingly secured.

The Sub-Committee, after this, got very quickly to work in making arrangements for the provision of the necessary accommodation and equipment for their experiments, and by 31st March last, practically all the plant and appliances required were on the site and ready for use.

The majority of the female stock required for the experiments was purchased at the auction sales held at the Egg Laying Trials in Lancashire in November, 1923. These included good layers as well as bad layers, of the following breeds: White Wyandotte, White Leghorn, Rhode Island Red. The initial stock were mated during the third week in March, and the poultryman to conduct the experiments was engaged to take up his duties on 1st April last.

Southern Breeding Experiments.—The Sub-Committee which is dealing with the Southern Breeding Experiments in the production of table poultry held its first meeting on 25th September, 1923, and is at present constituted as follows: Principal R. M. Wilson, B.Sc., Chairman (nominated by the Ministry); Messrs. Harold Corrie, J. H. Dowden, A. P. F. Grant and the Revd. H. Mayall (nominated by the National Poultry Council); Mr. Thomas Neame, co-opted by the Sub-Committee in place of Dr. J. L. Rosedale (resigned); Mr. Nelson Kenward (nominated by the Ministry); Mr. A. S. Juniper, co-opted; and P. Hedworth Foulkes, B.Sc. (nominated by the Main Committee); with Mr. C. T. Stock, of the Ministry, as Secretary.

A site for the experiments has been generously provided by the Governors of Wye College and is situated on the College Farm, a water supply having been specially laid on to the site free of charge.

The Sub-Committee has decided to begin its work with experiments on the following lines:—

- (1) To ascertain the amount of weight and value of weight gained by various breeds and cross-breeds of poultry in relation to the weight and value of food consumed; also the feeding costs of finished fowls for the table and the best breeds or cross-breeds to use for this purpose.
- (2) To ascertain the most profitable methods of feeding and marketing birds produced as a by-product on commercial egg farms.
- (3) To ascertain the value for table purposes of the breeds most generally used by commercial egg farmers, as compared with the breeds and cross-breeds usually regarded as best for table use; also whether it is likely to be profitable for commercial egg farmers to continue producing chickens for table use, from the birds they usually keep, at times of year other than the usual season for hatching laying fowls, and, if so, what are the best methods of feeding and marketing the birds.

The experiments have been begun with a small number of breeding pens composed of the following breeds and cross-breeds: White Leghorn, White Wyandotte, Rhode Island Red, Light Sussex, Indian Game crossed with Light Sussex, and Silver Gray Dorking crossed with Light Sussex. All suitable eggs laid by these birds will, if practicable, be incubated under hens during the whole of the first year of the experiments, and the resulting chickens will be divided into four lots and marketed as: (a) Petit Poussins; (b) Chickens off the run; (c) Trough-fed chickens; (d) Chickens finished by cramming.

All the breeding stock has been purchased with the exception of two Silver Gray Dorking cockerels. Approximately 400 chickens have been hatched and will form the nucleus for the experiments. It has, however, unfortunately been necessary to kill off the Rhode Island Red chicks owing to an outbreak of what appears to be bacillary white diarrhoea. Blood samples are now being taken from the parent birds of these chicks with a view to examination at the Ministry's Veterinary Laboratory.

All the accommodation and equipment for the experiments has been provided and is now in use. A Manager-Recorder and a Poultryman have been appointed and took up their duties on 3rd March last. The Sub-Committee is at present engaged in some test experiments preparatory to a full year's work on the lines indicated above, which it is hoped will commence not later than the beginning of next year.

Note.—Three-fourths of the total capital expenditure in connection with all the work referred to above will be met by the Ministry out of grants from the Development Fund, the remaining one-fourth being contributed by the poultry industry. All the cost of maintenance is being provided for by the Ministry out of Development Fund grants.

* * * * *

LOANS TO CO-OPERATIVE ENTERPRISES.

The following are the terms and conditions under which loans will be made to Co-operative Enterprises:—

1. The Ministry of Agriculture will make loans to Agricultural Co-operative Societies registered under the Industrial and Provident Societies Acts to the extent of such funds as may be placed at its disposal. In order that a Society may be eligible for a loan the Society must have for its Object such agricultural purpose as may be approved by the Ministry, and its capital must be subscribed mainly by agriculturists. The share capital paid up by the subscribers must not be less than 5s. per £ share and the rate of interest on the paid up share capital must be limited to 5 per cent. In special cases, however, loans may be made to existing Societies whose rules allow a maximum interest of 6 per cent. provided an undertaking is given that while any part of the Government loan is outstanding the actual rate of interest paid on the share capital will not exceed 5 per cent.

2. The amount of the loan from the Ministry will not exceed (a) half the total amount considered by the Ministry to be

necessary for the proper equipment and working of the society, or (b) the amount of subscribed capital, whichever may be the less. No loan will be granted until the Ministry is satisfied that the remaining capital required for the proper equipment and working of the society will be available. Advances to existing societies will normally be made only for the purpose of improving or extending premises and plant.

3. In no case will the Ministry's loan exceed the sum of £10,000 to any one society.

4. In the case of a newly-formed society the loan will be secured by a first debenture upon all the assets (including uncalled capital) of the society. In the case of an existing society, it will be secured if possible by a first charge on the premises and plant obtained or improved with its assistance. If such a charge cannot be given, the Ministry will require other satisfactory security.

5. Interest will be charged on the loan at 5 per cent. per annum, and the loan will be repayable in instalments spread over a period not exceeding twenty years. Both interest and repayment of principal will be payable half-yearly. The first payment in respect of both interest and principal may be deferred by the Ministry for thirty months after the date when the loan is actually paid over, or, if the loan is made in more than one instalment, thirty months after the date when the first instalment is paid. The first payment to the Ministry will be six months' interest on the whole amount of the loan and one-fortieth of the principal.

No charge will be made on account of interest for the period from the date when the whole loan (or the first instalment as the case may be) is paid over up to a date six months before the first payment to the Ministry falls due.

6. The Ministry must reserve the right to require at any time immediate repayment of the principal of the loan and all outstanding interest, but there would be no intention to exercise this right so long as the Society was managed to the satisfaction of the Ministry. The Ministry will also have the right, if it so desires, to inspect the work of the Society and to be represented at meetings of the Committee of Management of any Society to which a loan is made.

7. The Society shall cause an audit of accounts to be made yearly by an Auditor approved by the Ministry and a copy of the Auditor's report and of the accounts shall be supplied to the Ministry. The books of the Society shall be open to inspection by an officer of the Ministry at any time.

AUGUST ON THE FARM.

J. R. BOND, M.B.E., M.Sc., N.D.A. (Hons.),
Agricultural Organiser for Derbyshire.

Weather Notes.—The normal weather of August is very like that of July; the differences are a slightly higher rainfall and a tendency towards lower temperatures. The duration of daylight (about 15 hours a day in August) and of bright sunshine continues to diminish from the maximum enjoyed in June. Normally, conditions are not quite so favourable to the quick and thorough drying of materials—mown grass, weeds in fallows, etc.—as in July; on the other hand the pastures, which seem to make no growth whatever during the seventh month, now begin to freshen again.

The beginning of August has often been a wet period, hence the term Lammas flood; but it sometimes happens that dry weather prevails during the early part of the month and a wet spell sets in about the time the crops in the midland and northern counties are ready for cutting. One of the most memorable harvests, characterised by weather of the latter kind, was that of 1918; in that year crops were well secured south of the Trent, but farther north the three-fold misfortune of lodged crops, shed grain and sprouted stooks was widespread.

Corn Harvest.—In the Midlands the usual order and typical dates for the commencement of cutting the cereals are as follows: winter oats, 3rd August; spring oats, 12th; wheat, 15th; and barley, 20th. Seasons vary greatly, however, as may be illustrated by reference to the fact that, whereas wheat-harvest began during the last week of July in 1921, this crop was not ready for cutting until the third week of August in the following year. As regards this year's harvest, present indications are that it will be rather late.

In mediæval times, Lammas—1st August—was celebrated by the offering of loaves baked from the flour of that year's crop; indeed, the word Lammas is derived from the Anglo-Saxon "Ilaf-mass" or Loaf-mass. The apparent earliness of the Old English harvest must, however, be discounted by the fact that in A.D. 1582 the calendar was altered, so that the Lammas of those days corresponds to 12th August in the modern calendar.

Ripening of Corn.—Cereals ripen continuously, but four successive stages may be recognised. The time required in passing from one stage or condition to the next depends on the season, the soil and, to some extent, the variety of the crop. In a hot dry August, corn may quickly pass from the green to the dead-ripe white condition, especially on sandy or shallow soils, whereas under the opposite conditions the grain may remain soft and waxy for an indefinite period. The four stages of ripeness are :—

1. *Milk-ripe.*—The entire plant, including the seed-skin, is green, and the “ seed ” or “ berry ” is full of a milk-like fluid. Usually the crop remains in this condition for about 5 weeks after flowering.

2. *Yellow-ripe.*—The plant, including the seed-skin, is yellow, only the knots in the stem remaining green. The seed has become waxy in texture; when pressed between the finger-nail and the thumb, it breaks but does not quash or exude milky fluid. Typically the crop passes from yellow to full ripeness in about a week.

3. *Full-ripe.*—The tinge of green has gone from the straw just below the ear and the seed does not now break but only bends on the finger-nail; but it also “ sheds ” more readily.

4. *Dead-ripe.*—The straw has become white and the knots have dried and shrivelled; the grain readily sheds, and, if the weather has been good, the seed is now hard and brittle.

In times when the loaf was made entirely of home-grown wheat, early cutting was advocated in the belief that grain so harvested yielded a stronger flour. It is now known that “ strength ” is chiefly a matter of the variety grown; and further, that if the crop is cut before attaining the yellow-ripe stage, it cannot fully complete the filling of its seed. Although there is little increase in the total weight of corn and straw after the crop has reached the milk-ripe stage, the transfer of food material from the leaves and stem to the grain continues for as long as the crop contains green colouring matter; and, as moisture is the vehicle, the stem must remain connected with the roots in the soil, until the green colour has entirely disappeared; this indicates that the process of food-transference is at an end. Failure of the soil-moisture supply or the lodging of the crop produces effects similar to those attributable to premature cutting, viz., a reduced yield and a high proportion of improperly filled grains.

Barley intended for malting is allowed to become dead-ripe—the ears bending over—to ensure unison in the germination of the sample and to allow of stacking with the least exposure and discoloration of the crop in stooks after cutting. Seed-corn of other cereals is likewise allowed to ripen to the third or fourth stage, chiefly because—as with malting barley—after full-ripening it germinates with greater unison. Corn cut somewhat early produces an irregular plant, unless the seed has been previously stored dry for some months. Obviously, therefore, complete ripening is more necessary in the case of seed intended to be sown in the ensuing autumn than it is for spring cereals.

With cereals other than malting-barley and autumn seed-corn, cutting may begin as soon after the yellow-ripe stage has been reached as weather conditions permit. Perfectly regular ripening is, however, rarely seen in practice, thin crops especially often having late tillers: waiting for these may involve shedding of the top corn of the earlier shoots and perhaps incur a waste of good weather. Where the labour supply is short, and generally when good-ripening weather prevails, cutting should begin rather on the early side. In unfavourable weather, ordinary crops take least harm while uncut; rank crops, likely to lodge, however, are an exception to this rule.

Self-Binders.—The operation of a self-binder affords opportunity for the exercise of mechanical instincts, to prevent or correct the various troubles that occasion costly delays in the harvest field. Into the details of that subject it is not intended to enter; but mention may well be made of the fact that one of the common troubles—the machine throwing out sheaves with untied or broken bands—is often attributable to the neglect of simple details, such as omitting to sharpen the twine-knife or to grease it to prevent its rusting, and attempting to tighten the sheaf by increasing the tension on the twine between the can and the needle.

The machine makes straight-butted sheaves only when the cut grain is correctly delivered to the sheaf-making mechanism: the heads and the butts must arrive at the binding deck simultaneously. If either the heads or the butts come down first, the resulting sheaf will have an oblique base. To ensure the cut grain being correctly delivered to the sheafing-apparatus, the slope of the platform must be adjusted, so that the arrival of the heads on the first canvas is either delayed or hastened as may be required: and the reel must be so operated as to increase the effect of the adjustment of the slope of the platform.

The size and tightness of the sheaf must vary according to the condition of the crop, the date of cutting, the climate, and the absence or presence of green material in the butts. Under good and early conditions, sheaves weighing when dry about 10 lb. are about the right size; but in late and moist districts, half that weight may be recommended, in spite of the greater expense incurred by the larger twine consumption. In an ordinary four-quarters crop of wheat, a 6 ft. machine drops a sheaf every $4\frac{1}{2}$ yards, when set to make sheaves that weigh 10 lb. at stacking time; in this case there are 550 sheaves per acre.

Stubble Cultivations.—It may often be observed that the land is rather soft when the reapers are at work; but, by the time the crop has been housed, the soil has become so hard-baked as to be unworkable with horse-drawn implements. The shade of the crop, especially that of a dense crop, keeps the soil-surface in a tilth; but this soon disappears under the influence of drying weather, after the crop has been cut. For this reason, immediate attention to the stubbles may greatly expedite later workings. Metaphorically, the skimming plough should be hitched behind the reaper: in practice, stubble working may begin as soon as the corn is in stook.

A dry autumn enables considerable progress to be made with the eradication of weeds of the couch or twitch type, if the soil can be stirred before it has hardened. The stubble should be ploughed about three inches deep, to lift the weedy layer; and this may with advantage be drawn up in small ridges, after the fashion of the work of the Kent broadshare. In due course the weeds are worked out, dried and collected. Unfortunately, the eradication of such pests by working-out and collection can rarely be made a complete success; nearly always sufficient is left in the land to start another "crop" of the weed.

As regards some of the most troublesome annual weeds, such as charlock and poppy, shallow working of the stubbles (with a view to inducing the germination of the seeds shed from this season's growth) yields disappointing results. The seeds of these two weeds appear to require a resting period, as only a very small percentage of the new seed will germinate in time to be destroyed by later autumn workings or by the winter weather. Deep ploughing, on the other hand, does not destroy the weed-seeds: when so buried they remain alive for years, and germinate when brought up again during the workings for some future crop. Where it is possible to give charlock-infested land

an autumn cleaning, the ploughing should be deep enough to bring up seeds that have been lying dormant during the past season. The seed of spurrey, a very troublesome weed on light, sour soils, does germinate in the autumn of the year in which it is produced; hence in this case the formation of a shallow surface tilth (such as would be made if attempting to secure a catch crop of crimson clover) is a valuable aid to the reduction of this pest.

Wheat after "Seeds" and Bare Fallow.—It has long been a rule of good husbandry to plough "seeds" stubbles early when intending to follow with wheat. Early ploughing ensures more complete decay of the stubble and root residues and averts the danger of a "root-fallen" plant. Under dry conditions, also, early ploughing is desirable to prevent the land being dried out too deeply by the growth of aftermath. A third reason for early ploughing applies particularly to grassy leas, but not to pure clovers, viz., that it protects the wheat crop against frit fly attack: this matter is explained in the Ministry's Leaflet No. 202 (*The Frit Fly*). On the other hand, early ploughing may attract the Wheat Bulb Fly, which lays its eggs on bare soil in the summer—see Leaflet No. 7. The injury done by each of these pests is often wrongly ascribed to wire-worm, to bad weather and to other causes. Every case of loss of wheat plant in the winter should, therefore, be reported for investigation by the Entomologist attached to the provincial agricultural college.

White Winter Oats.—The writer would appreciate reports of experiences with white winters during the past season, particularly with a view to ascertaining the effect of date of drilling and degree of consolidation of the land before sowing. Reports of cases where blacks or greys were sown at the same time, etc., as whites would be of special value. Address:—County Education Office, Derby.

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NOTES ON POULTRY KEEPING.

C. A. FLATT,

Ministry of Agriculture and Fisheries.

Management of Cockerels and Pullets.—Chicken rearing troubles are practically over and the young birds growing apace. On the farm, following hay harvest, with the Sussex arks out in the fields, the young cockerels come on so rapidly that every week of fresh "draft" is under orders for the fattening crates.

Although there is an abundance of natural food for them, it pays to provide a generous supply of cereal food at this stage in their growth, in the form of wet mash or boiled wheat, for the birds destined for market. A bird in good condition will make a better finish in the fattening crate than the lean specimen with all its weight in the frame. There is a period, too, when table condition is hard to keep, and at this season it is not economical to retain cockerels, other than those intended for breeding stock, over this period. This applies not only to poultry keepers with limited land accommodation but to farmers, where the provision for housing the poultry is so frequently inadequate.

A fowl weighing 4-4½ lb. is in general demand; larger than this it is seldom worth while to produce at seasons other than Christmas and later hatches will provide Christmas birds.

The pullets also make rapid development, with everything in their favour for growth. Often, this is too rapid, and it is a mistake to run cockerels and pullets together and so hasten maturity. A pullet that commences to lay at 4½-5 months of age seldom makes the required growth, the eggs are small and frequently fail to attain the necessary standard at a later stage.

While it is always a problem to check the early pullets from laying prematurely, there is no doubt that the diet is too stimulating in many cases, and the use of all animal food might well be dropped while there is insect food in abundance. A broader ration with cereal foods, largely grain, will produce the incentive to the birds to forage and develop more naturally.

It was a matter for surprise when handling many of the pullets on arrival at a leading laying test last season, to find so large a percentage without an ounce of surplus fat on their bodies. There should be some surplus at the commencement of a strenuous period of egg-laying, and the diet of a growing pullet can with advantage be broader than that of the laying bird, in order to make this provision.

Stubbles on the Farm.—From present appearances, the harvest will be well under way by the time these notes appear, at least in the south, and in all probability a good deal of corn spilled from the ear will be lying on the ground. Here the poultry flocks come in again to assist the profit on the farm.

There is nothing so handy as the Sussex night ark as shelter for the birds on the stubbles. Well-ventilated and consequently suitable to accommodate a number of young birds, they are light and easy to cart from one field to another as the corn is cut.

Turkeys and geese can be driven out to the fields to glean and brought back in the evening, if necessary, but it would frequently be more expedient to put up rough shelters in the corners of the fields. But for the danger from foxes, and in some parts from theft, no provision would be required for the turkeys in the open other than perches.

Turkey Rearing.—The annual crop of turkey rearing troubles has arisen. Absence of ventilation in night shelters is a fruitful cause of trouble. The young birds are left with the ordinary hen until they are taller than she is. This is a good plan, as turkeys are notoriously silly things, even for poultry, and the hen provides useful guidance and some protection, but it is a fatal mistake to leave them too long in the coop, even when this is a large turkey coop. The young birds want space and air at night, but the coops, when shut up, get hot and stuffy, especially with the early morning sun, and when let out the birds are liable to chill on top of the evil of vitiated air during the night.

It is not easy to regulate conditions, and turkey rearing needs careful attention. The hot days and cold nights following, in a draughty house, may cause loss, but even this is less fatal than stuffy conditions. Plenty of air is necessary, and proper ventilation eliminates draughts.

Turkey rearing on any large scale cannot be recommended without plenty of space for the birds to roam and to feed naturally. Turkeys require a lot of green food, are at the best dainty feeders, and the absence of fresh green food and an excess of starchy foods will bring troubles.

The birds do well when roaming the stubbles. Fresh land is a boon in turkey rearing and will do much to tide over the dangers of "Blackhead." Of cures for this disease in turkeys very little is known, as of turkey ailments in general, and it is probable that many cases are wrongly diagnosed as "Blackhead" where losses occur from symptoms which are similar. The individual doctoring of a turkey is a thankless task, and upon the appearance of illness in a flock, isolation of any sick birds and removal of the healthy birds to fresh ground, with careful disinfection of houses, drinking vessels, etc., is a wise precaution to be taken speedily. It is well to restrict the area of the fresh ground at first, in order to limit the possibilities of further infection of the land.

Some of the early losses are occasioned by lice, which are often not detected until the bird is thoroughly infested, by

which time it may have suffered past recovery. The hen used for rearing should be clean and healthy, a point often overlooked.

Treatment for Laying Hens.—Many of the older laying hens will be cleared out at Michaelmas, or a little later. These are just the type of stock for “ stubbling ” after the later harvests. It is a season when the pullets intended for autumn production need to be settled in their permanent quarters and, if they are on the stubbles too late, removal after they have begun to lay is likely to cause a check and a moult amongst some which is liable to spread through the flock. The hens which in any case cannot be depended upon for production in the scarcer season will often produce heavily through September with a change of ground and abundant food on the stubbles, and, if not left too long, when the shed grain is cleared and food becomes harder to secure they can be taken up and sold while still in good condition.

Blackberry Chickens.—It is questionable whether late summer hatching is worth the while of the poultry farmer, whose accommodation and labour is usually better employed in the production of winter eggs. But upon the general farm “ blackberry ” chickens are very profitable. The breeding stock is generally still in good condition and, with the use of hens for hatching and rearing, the chicks are little trouble in their earlier stages. With good poultry management on the farm, before the end of October the earlier pullets are in their winter laying quarters, and the hens are reduced by culling to a minimum, consisting of those required for the following season’s breeding and the others worthy of retention for egg production. The smaller houses or arks used for rearing will then be available for these late-hatched chicks and, although growth at this season is less rapid, feeding on the farm is less costly. The young birds do well in the shelter of the corn stacks, where they always pick up a certain amount of their own living and, after thrashing, turn the spilled grain to good account. Sold at Christmas and in the two succeeding months, when poultry is always scarce, they make very good prices.

The farmer who does not wish to invest capital in laying houses is far better advised to sell his pullets, for which there is a great demand in the autumn, at lucrative prices, than to keep them in small houses with inadequate shelter, frequently overcrowded, and to use the small houses, as previously indicated, for batches of late chickens.

MONTHLY NOTES ON FEEDING STUFFS.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.),
School of Agriculture, Cambridge.

The Use of Green Food for Fattening Pigs.—In a recent number* of the Journal of the Irish Department of Agriculture appears a paper by E. J. Sheehy summarising the results of experiments on pigs carried out at Ballyhaise, Athenry and Clonakilty. These experiments, which were commenced in 1922, were designed to test the possibility of replacing separated milk and meals in a pig's dietary by green food, to ascertain the economic extent of such replacement, and to discover whether the value of a ration was enhanced by the addition of green food.

Crowther,† in this country, had already shown that, with growing pigs, no advantage in the rate of growth was obtained by adding a small allowance of green food to a ration consisting largely of cereal products and fish meal. This conclusion was subsequently confirmed by White and Roberts.‡ In the Ballyhaise trials, the green food fed was rape or vetches and oats; in the Athenry trials, green oats, vetches, cabbage and turnip tops; and at Clonakilty green rape. As the result of these experiments, the following conclusions were arrived at:—

(1) Cereal meals or separated milk may be partially replaced by green food, but the extent to which this may be done is strictly limited by the inability of the pig to deal with large quantities of bulky fodder.

(2) The extent of the replacement possible is, for a fattening pig, represented by 6 lb. of green food per day; this, according to these trials, represents 3 pints of separated milk or $\frac{3}{5}$ lb. of meal.

(3) In the case of the lots fed on rape, a bacon-curing test was carried out, and the report indicated that the feeding of green rape led to the production of inferior bacon. It does not necessarily follow that other green foods would have a similar deleterious effect, but the possibility of such an adverse effect following the feeding of green food to bacon pigs should be borne in mind by pig feeders. In any case, it would be desirable to discontinue feeding green food during the last month of fattening.

* Journal of the Ministry of Agriculture and Technical Instruction, Dublin, Vol. XXIV, No. 1, May, 1924.

† Bulletin No. 3, Olympia Agric. Co.

‡ This *Journal*, Vol. XXX, p. 27.

DESCRIPTION.	Price per Qr.		Price per		Manurial Value per Ton.	Cost of Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv.	Price per lb. Starch Equiv.
			Cwt.	Ton.					
	s. d.	lb.	s. d.	£ s.	£ s.	£ s.		s.	d.
Wheat, British - -	—	—	12/3	12 5	0 15	11 10	71·6	3/3	1·74
Barley, Argentine - -	36/-	400	10/1	10 2	0 12	9 10	71	2/8	1·43
Karachi - -	35/-	—	9/10	9 17	0 12	9 5	71	2/7	1·38
Persian - -	32/3	—	9/-	9 0	0 12	8 8	71	2/4	1·25
Oats, English, White -	—	—	10/4	10 7	0 13	9 14	59·5	3/3	1·74
" " Black and Grey - -	—	—	9/6	9 10*	0 13	8 17	59·5	3/0	1·61
Canadian :—									
No. 2 Western	27/-	320	9/5	9 8	0 13	8 5	59·5	2/11	1·56
No. 3 " "	26/-	—	9/1	9 2	0 13	8 9	59·5	2/10	1·52
Feed - -	25/-	—	8/9	8 15	0 13	8 2	59·5	2/9	1·47
" American - -	22/-	—	7/8	7 13†	0 13	7 0	59·5	2/4	1·25
" Argentine - -	23/-	—	8/1	8 2	0 13	7 9	59·5	2/6	1·34
" Chilean - -	22/-	—	7/8	7 13†	0 13	7 0	59·5	2/4	1·25
Maize, American - -	40/6	480	9/5	9 8†	0 13	8 15	81	2/2	1·16
" Argentine - -	38/-	—	8/10	8 17	0 13	8 4	81	2/0	1·07
Beans, Rangoon - -	—	—	10/1	10 2†	1 11	8 11	67	2/7	1·38
Peas, Japanese - -	—	—	21/9	21 15†	1 7	20 8	69	5/11	3·17
Millers' Offals :—									
Bran, British - -	—	—	—	6 10	1 6	5 4	45	2/4	1·25
" Broad - -	—	—	—	7 5	1 6	5 19	45	2 8	1·43
Middlings—									
Fine, Imported	—	—	—	9 12	1 1	8 11	72	2/5	1·29
Coarse, British	—	—	—	9 0	1 1	7 19	64	2/6	1·34
Pollards, Imported - -	—	—	—	6 17†	1 6	5 11	60	1/10	0·98
Meal, Barley - -	—	—	—	10 15	0 12	10 3	71	2/10	1·52
" Maize - -	—	—	—	11 0	0 13	10 7	81	2/7	1·38
" " Germ - -	—	—	—	8 12	0 18	7 14	85·3	1/10	0·98
" " Gluten Feed - -	—	—	—	8 15	1 6	7 9	75·6	2/0	1·07
" Locust Bean - -	—	—	—	8 5	0 9	7 16	71·4	2/2	1·16
" Bean - -	—	—	—	13 0	1 11	11 9	67	3/5	1·83
" Fish - -	—	—	—	18 10	4 3	14 7	53	5/5	2·90
Linseed - -	—	—	—	20 11	1 10	19 1	119	3/2	1·70
" Cake, English	—	—	—	—	—	—	—	—	—
12% Oil - -	—	—	—	12 12	1 17	10 15	74	2/11	1·56
" 10% Oil - -	—	—	—	12 2	1 17	10 5	74	2/9	1·47
" 9% Oil - -	—	—	—	11 17	1 17	10 0	74	2/8	1·43
Soya Bean Cake 6% Oil - -	—	—	—	11 5*	2 12	8 13	69	2/6	1·34
Cottonseed Cake, English	—	—	—	—	—	—	—	—	—
5½% Oil - -	—	—	—	8 2	1 13	6 9	42	3/1	1·65
" " Egyptian	—	—	—	—	—	—	—	—	—
5½% Oil - -	—	—	—	7 17	1 13	6 4	42	2/11	1·56
Decorticated Cotton	—	—	—	—	—	—	—	—	—
Seed Meal 7% Oil - -	—	—	—	12 15	2 12	10 3	71	2/10	1·52
Coconut Cake 6% Oil - -	—	—	—	9 12	1 9	8 3	73	2/3	1·20
Ground Nut Cake 7% Oil - -	—	—	—	9 5*	1 15	7 10	56·8	2/8	1·43
Decorticated Ground	—	—	—	—	—	—	—	—	—
Nut Cake 7% Oil - -	—	—	—	11 7*	2 13	8 14	73	2/5	1·29
Palm Kernel Cake 6% Oil - -	—	—	—	6 17†	1 2	5 15	71·3	1/7	0·85
" Meal 2% Oil - -	—	—	—	6 17	1 3	5 14	71·3	1/7	0·85
Feeding Treacle - -	—	—	—	7 7	0 8	6 19	51	2/9	1·47
Brewers' Grains :—									
Dried Ale - -	—	—	—	6 17	1 3	5 14	49	2/4	1·25
" Porter - -	—	—	—	6 7	1 3	5 4	49	2/1	1·12
Wet Ale - -	—	—	—	1 1	0 9	0 12	15	-10	0·45
" Porter - -	—	—	—	0 16	0 9	0 7	15	-6	0·27
Malt Culms - -	—	—	—	8 0†	1 13	6 7	43	3/-	1·61

* At Hull. † At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of June and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose coconut cake is offered locally at £10 per ton. Its manurial value is £1 9s. per ton. The food value per ton is therefore £8 11s. per ton. Dividing this figure by 73, the starch equivalent of coconut cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·26d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices :—N, 12s. 5d.; P₂O₅, 4s.; K₂O, 2s. 6d.

FARM VALUES.

CROPS.	Market	Value	Starch	Food	Manurial	Value per
	Value per	per				
	lb. S.E.	unit	Equivalent	Value per	Value per	Value per
	d.	S.E.	per 100 lb.	Ton.	Ton.	Ton on
		s. d.		£ s.	£ s.	Farm.
Wheat - - - - -	1·07	2 0	71·6	7 3	0 15	7 18
Oats - - - - -	1·07	2 0	59·5	5 19	0 13	6 12
Barley - - - - -	1·07	2 0	71·0	7 2	0 12	7 14
Potatoes - - - - -	1·07	2 0	18·0	1 16	0 3	1 19
Swedes - - - - -	1·07	2 0	7·0	0 14	0 2	0 16
Mangolds - - - - -	1·07	2 0	6·0	0 12	0 3	0 15
Good Meadow Hay - - -	1·25	2 4	31·0	3 12	0 13	4 5
Good Oat Straw - - -	1·25	2 4	17·0	2 0	0 6	2 6
Good Clover Hay - - -	1·25	2 4	32·0	3 15	1 0	4 15
Vetch and Oat Silage - -	1·16	2 2	14·0	1 10	0 7	1 17

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	Average Price per ton during week ending July 16th.					Cost per Unit at London
	Bristol	Hull	L'pool	L'ndn		
	£ s.	£ s.	£ s.	£ s.	s. d.	
Nitrate of Soda (N. 15½ per cent.)	14. 5	...	13.12	13.12	17. 7	
" " Lime (N. 13 per cent.) ... ..	...	12.10	...	12.10	19. 3	
Sulphate of Ammonia, ordinary (N. 20.7 per cent.)	12.17*	12.17*	12.17*	12.17*	(N)12. 5	
" " " neutral (N. 21.1 per cent.)	14. 0*	14. 0*	14. 0*	14. 0*	(N)13. 3	
Kainit (Pot. 12½ per cent.) ... ..	...	...	...	2. 5	3. 7	
French Kainit (Pot. 14 per cent.)	2.10	2. 6	2. 5	2.12	3. 9	
" " (Pot. 20 per cent.) ... ..	...	2.10	...	2.17	2.10	
Potash Salts (Pot. 30 per cent.) ... ..	...	...	...	3.15	2. 6	
" " (Pot. 20 per cent.) ... ..	...	...	2.10	2.15	2. 9	
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7. 5	7.10	7.10	3. 0	
Sulphate of Potash (Pot. 48 per cent.) ...	...	11. 5	11.10	11.10	4. 9	
Basic Slag (T.P. 30 per cent.) ... ..	...	...	2.12§	2.12§	1. 9	
" " (T.P. 28 per cent.) ... ..	...	2. 1†	...	2.10§	1.10	
" " (T.P. 26 per cent.) ... ..	...	1.14†	...	2. 8§	1.10	
" " (T.P. 24 per cent.) ... ..	...	1.11†	2. 0§	2. 6§	1.11	
Superphosphate (S.P. 35 per cent.) ...	4. 4	...	3.15§	3.10	2. 0	
" " (S.P. 30 per cent.)	3.16	3. 7	3. 8§	3. 2	2. 1	
Bone Meal (N. 3¼, T.P. 45 per cent.) ...	9. 0	8.15	8.10	8. 0	...	
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	6.17†	6.15†	6. 0	6. 2†	...	
Fish Guano (N. 7¼-8¼, T.P. 16-20 per cent.)	12.15	...	13. 0	...	...
" " (N. 9, T.P. 10 per cent.) ...	...	...	...	13.10	...	

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named.

THE Summer Inspection of the new varieties planted in the Ormskirk trials of the immunity of potatoes from wart disease

**Ormskirk
Potato Trials,
1924.**

will take place on Thursday, 14th August. Attendance on this day is by invitation from the National Institute of Agricultural Botany, but the trial grounds are open to all interested in potato growing on the 15th and 16th August. The trials are being carried out at the Potato Testing Station at Lathom, Ormskirk. The Ministry of Agriculture and Fisheries is the responsible authority for the decision and certification as to which varieties are immune from wart disease. The extensive plots of potatoes planted at the station include a large number of varieties from Australia, France, and other foreign countries, and also a considerable number of seedlings from plant breeding institutions, potato raisers and others.

The other trials of the Institute will be open to inspection. They consist of maturity and yield trials of first early potatoes; the Lord Derby Gold Medal Trials, carried out in conjunction with the Ormskirk Potato Society; and a trial of the new wheat Yeoman II, which is being marketed by the Institute this autumn. There is also a large number of demonstration plots of most commercial kinds of immune varieties of potatoes. An inspection of these should be of value to all interested in the potato crop.

* * * * *

FIGS are grown in pots and boxes, and also in narrow shallow borders $3\frac{1}{2}$ ft. by $1\frac{1}{2}$ ft. deep, composed of good loam and lime rubble made very firm. Brown Turkey is

**The Cultivation
of Figs for
Private Use.***

the variety which is mostly favoured. It is a free bearer and a good all-round variety. The trees are planted in borders and trained fan shape to wires 18 in. from the roof glass. When grown in pots they are usually trained to bush shape.

They are started in January with a night temperature of 60 deg. F. rising with sun heat in the day to 80 deg. and should be syringed freely twice daily, morning and afternoon.

When the shoots have made four leaves the point should be pinched out and succeeding growths also pinched at four leaves. When the fruit which has set upon last year's wood is swelling, plenty of water should be given to the roots as well as a light dressing of a good chemical manure, alternated with manure water. As the spring advances the night temperature may be raised to 65 deg. The house should be shut up early

* See *Fig Cultivation*, this *Journal*, March, 1924, p. 1153.

in the day so that the temperature will rise to 90 deg.; the trees should be freely syringed to ensure a moist atmosphere.

The first crop will ripen early in June; a second crop produced on the young wood will ripen in August. In order to produce the brown tint and a fine flavour so much desired, figs require abundance of light.

Red spider is the great enemy of the fig tree, but constant attention to syringing and watering should keep this pest down. In the case of a bad attack the bark should be sponged. During dull, cloudy weather following a spell of hot sunny days, the fruit is liable to split. To avoid this more ventilation must be given, and the afternoon syringing must be stopped, simply damping the floor taking its place for a time.

* * * * *

A NEW kiosk has recently been opened at the Royal Botanic Gardens, Kew, for the sale of Guides and other publications relating to the gardens. It is situated at the west end of the Museum of Colonial Timbers, No. 3, near the Main Entrance from Kew Green, and it replaces the former kiosks outside the Main Entrance and at the Victoria Gate. The new Illustrated Guide (published at 1s.) contains thirty photographs and a map of the gardens, as well as descriptive tours indicating to visitors how best they may utilise their time at the gardens.

For students who desire to investigate the treasures of Kew more intimately, the sixpenny Popular Official Guide is recommended, whilst the guides to the various Museums provide handy reference books for one's home library in addition to fulfilling their purpose of indicating the more important articles of economic interest displayed. These guides have been designed to meet the needs of visitors for whom it has been found impracticable, owing to the extent of the gardens, to arrange the services of a guide lecturer as has been done in other public institutions. A new edition has also been published of the Key Plan, on the back of which is printed a list of the principal objects of interest, each with a map reference so that occasional visitors can readily find their way about the gardens. The price of this Key Plan is 3d.

It should be mentioned that a complete new series of 63 postcards illustrating views and principal features of the gardens and specimen trees and plants, has been specially prepared and is now also on sale at the kiosk. They are published in nine sets of seven cards at 6d. a set.

THE judge's report on the competitions for the best managed small holdings held in connection with the Bath and West Society's Meeting at Taunton has recently been issued. There were two classes—one for holdings of from 15 to 50 acres, and one for those from 1 to 15 acres, limited in each case to ex-Service tenants under

**Small Holdings
Competitions at
the Bath and
West Show.**

the Somerset County Council. With regard to Class I, the judge's report refers to the satisfactory standard attained, in particular by the four prize winners, and, while offering some criticisms with regard to some of the other entrants, he stated generally "out of 18 entrants in this class, I was favourably impressed by the standard of farming shown by the large majority of the entrants and likewise by the number and type of stock kept upon the holdings. The cows were, for the most part, of a particularly useful quality."

In the case of the smaller holdings the judge states:—"The outstanding feature in this class is the hard work and enterprise shown by the winners of the three prizes, in converting ordinary farm arable into practically self-supporting market garden holdings, in a comparatively short space of time. Not only does the cropping and general management of the holdings reflect great credit upon the men, but their method of disposing of the produce, in an already crowded market, speaks well for their business capabilities. They are, however, somewhat handicapped by the difficulty in obtaining a sufficient supply of manure at a reasonable cost."

The judge adds that he found the tenants in both classes to be in a contented and optimistic frame of mind, and that they felt confident, if present prices are maintained, of their ability to continue the success which they have already achieved.

* * * * *

An instance of the value of the Statutory Small Holdings Scheme for people of the farm labourer class has been brought

**Value of Small
Holdings Schemes
to Farm Labourers.**

to notice in connection with the re-letting of a holding in Lincolnshire. The accepted applicant is an ex-Service man, the son of a farm labourer who was working on the farm in question when it was taken over by the County Council for small holdings 15 years ago. This labourer was placed on a cottage holding comprising 5 acres of very

good land, and has made a great success of it. The ex-Service son has saved £250, and has now been provided with the opportunity to settle down on a 25-acre holding.

* * * * *

In their Interim Report on Meat, Poultry and Eggs, the Linlithgow Committee call attention to the fact that there is

The Bacon Pig. a serious disagreement between breeders as to the best type of pig for bacon purposes; they recommend that the Departments of Agriculture should take the lead, and, in collaboration with curers, should make a definite and authoritative pronouncement as to the best type of pig to produce, due allowance being made for variations in local requirements.

In consideration of this recommendation the Ministry recently issued in leaflet form the article on "The Bacon Pig" which appeared in this *Journal* in December last, p. 788. The leaflet deals in outline with the standard which should be aimed at in producing the best type of pig for curing, the best breeds and methods of breeding, and the system of feeding designed to produce the best quality bacon.

Copies of the leaflet have been sent to the various County Agricultural Education Authorities in England and Wales, and to the Agricultural Colleges and Agricultural Departments of Universities and University Colleges, with the suggestion that such opportunities as may present themselves may be taken of encouraging the production of the best type of bacon pigs in this country. The great interest that has been shown by County Education Authorities in the subject is evidence that the matter is regarded as of considerable importance to agriculture at the present time. A copy of the leaflet may be obtained on application to The Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

* * * * *

THE Annual Report of Proceedings under the Tithe, Copyhold, Inclosure, Commons and other Acts for the year 1923

Proceedings under the Tithe, Copyhold, etc., Acts for 1923. contains the particulars which the Ministry is required annually to furnish of its transactions under the Acts mentioned, and includes, *inter alia*, an estimate of the amount of tithe rentcharge now existing

and in the hands of the various classes of titheowners; a summary of the effect of the Tithe Act, 1918, in stimulating

redemption of tithe rentcharge, together with details of the number of redemptions, mergers, altered apportionments, etc., of tithe rentcharge and other similar charges effected under the Tithe Acts, 1836 to 1918; of enfranchisements of copyhold carried out under the Copyhold Act, 1894; and of Regulations and Inclosures of common land and exchanges of land under the various Inclosure and Commons Acts during the year 1923. Tables giving similar information for previous years, which will be found useful for purposes of comparison, are also appended.

The first and longest section of the Report, which deals with transactions under the Tithe Acts, contains, however, in addition to the particulars mentioned, a considerable amount of information relating to tithe rentcharge and similar charges on land which should at the present time when tithe questions are attracting a more than normal degree of public interest, be useful to both owners and payers of tithe rentcharge, especially to such as are contemplating the redemption, merger or altered apportionment of such charges.

An explanation is given in some detail, for example, of the method whereby the compensation for redemption of tithe rentcharge is arrived at under the Tithe Act, 1918, including the provisions of that Act for redemption by annuity and of the effect of rates and land tax paid by the titheowner in respect of tithe rentcharge in the amount of the compensation to be paid on redemptions, whilst figures of the approximate number of years' purchase of the tithe rentcharge to which such compensation has amounted are given for typical average cases during the period under review.

The reasons for the desirability of securing legal altered apportionments through the Ministry in cases where areas charged with one tithe rentcharge have become divided in ownership are indicated, and the effect of informal apportionments of such rentcharge, as to which there is much popular misconception, is explained.

Further sections of the Report of interest are that containing particulars of enfranchisements effected under the Copyhold Act, 1894, as to which there are indications that the number of applications for enfranchisement will probably increase before the provisions of the Law of Property Act, 1922, relating to this subject come into operation, and that dealing with the progress of the Regulation of Commons in the country during 1923, in which connection it is observed that a few very small areas of common land were enclosed for certain public purposes.

The Swiss Fruit Crop.—Not only in this country is the fruit crop this year above the average, but the most recent report of the Swiss crop shows that, according to provisional estimates, there will be an excess of about 16,700 wagons of cider fruit, 7,900 wagons of dessert apples, 10,200 metric tons of plums and 1,400 metric tons of walnuts for exportation. New export markets will have to be found for this surplus fruit.

* * * * *

Foot-and-Mouth Disease.—It is unfortunately necessary to record an increase in the number of outbreaks of foot-and-mouth disease since the July issue of the *Journal*. In the week ended 29th June, 18 outbreaks occurred (1 each in Berks, Chester, Northants, 3 in Surrey, 4 in Oxford and 8 in Notts); in the week ended 6th July, 20 outbreaks (1 each in Bucks, Surrey, and Warwick, 2 each in Berks and Herts—the latter a new centre, 3 in Northants, 4 in Notts and 6 in Oxford); and in the week ended 13th July, 11 outbreaks (1 each in Berks, Isle of Ely—a new centre, and Northants, 3 in Oxford and 5 in Notts). In the week ended 20th July, 22 outbreaks occurred (9 in Dorset, 1 each in Kent and Worcester, 6 in Oxford and 5 in Notts. The outbreaks in Dorset, Kent and Worcester involved new districts).

The total number of outbreaks from 27th August, 1923, to 20th July, 1924, is 3,198 involving 42 counties in England, 2 in Wales and 12 in Scotland. The numbers of animals slaughtered amount to 106,707 cattle, 45,475 sheep, 49,061 pigs and 129 goats, the gross compensation being £3,401,000 and the estimated salvage £509,750.

* * * * *

Rabies.—A case of rabies was confirmed on the 18th June, in an imported dog brought from India. The dog was landed on the 27th December, 1923, but died of rabies on the 13th June, nearly six months after its arrival in this country. Allowing for the period of the voyage the incubation period in this case must have exceeded six months. A notice detaining the companion dog imported with the rabid animal for a further period of one month, in quarantine, has been issued under the Rabies Order of 1919. This is the third case of rabies in imported dogs whilst undergoing quarantine during the current year.

* * * * *

Exhibition at Heysel-Laeken (Brussels).—A National and International Exhibition of Novelties bearing on urban and rural household work will be held at Heysel-Laeken (Belgium) from 15th July to 15th August, 1925. This exhibition, organised with the collaboration of Government Departments local governments, agricultural associations and other Belgian organisations, has as its object to bring before housewives means of facilitating their work or increasing its efficacy, particularly through new or improved appliances. Exhibits are invited from inventors and manufacturers abroad, who are asked to enter as soon as possible, before 1st April, 1925. Entries should be addressed to the Secrétariat Général, 40, Rue des joyeuses Entrées, Louvain.

The Classes for exhibits are very comprehensive, including, for example, milking by machinery, garden equipment, kitchen and household apparatus, cleaning materials, furniture, sanitation, etc.

NOTICES OF BOOKS.

Agricultural Progress.—(The Journal of the Agricultural Education Association. London: Ernest Benn & Co., Ltd. Price 5s. net.) There has recently been published the first number of a new journal with the arresting title of *Agricultural Progress*. This publication is the official organ of the Agricultural Education Association—a body which, although founded in 1894, has not hitherto attracted public notice. The Association includes the great body of the workers engaged in agricultural education and research in England, Scotland and Ireland—Professors, Lecturers, and County Organisers—and, in a sense, may be regarded as the scientific brains of the agricultural industry.

It is interesting to learn that the Association was invited to give evidence before the Tribunal of Economists appointed by Mr. Bonar Law's Government. In the publication under notice, we find a memorandum embodying the main heads of the evidence given on behalf of the Association. It may be interesting to record the names of three witnesses actually selected to give evidence. They were Mr. James Mackintosh, of the National Dairy Research Institute, Reading, who dealt with possible economic advances in regard to milk production; Professor W. Somerville, who testified regarding grass improvement, a subject upon which he is an acknowledged authority; and Mr. James Brown, who was deputed to advocate the intensified system of forage farming, of which he is a well-known exponent. The extended title of the Memorandum above referred to is "The contribution of Agricultural Education towards the alleviation of the present Agricultural Crisis."

It is unnecessary to mention in any detail the specific remedial measures suggested in the Memorandum. Most of them have already been noticed and discussed at one time or another in the technical press. Growers of potato seed, however, should notice that the Memorandum envisages the possibility of producing seed in England equal to Scotch seed; for it is suggested that the existing superiority of the latter is mainly due to its being free from infection by virus diseases, such as leaf curl, mosaic, etc. It is also recommended that the growing of silage crops should be largely extended. A vigorous attack is made on the use of compound fertilisers and feeding stuffs, sold under proprietary names. The Fertilisers and Feeding Stuffs Act offers, it is said, insufficient protection, and it is suggested that legislation on the Canadian model should be adopted. In Canada every proprietary fertiliser must be registered with the Minister of Agriculture, together with a statement of the description of each material from which the fertiliser is made. The statement of the analysis only, unintelligible as it is to the average farmer, gives no protection so far as price is concerned.

When all is said, however, it must be admitted that the sovereign specific for present ills is largely a spiritual one, the fostering of a belief that human endeavour alone can, and will, provide a remedy. Hard work, both physical and mental, has not hitherto failed to "win through"; and hard mental work is not possible apart from a familiarity with the benefits that education and study alone can provide.

"Agricultural" progress is not a matter of the adoption of this or that nostrum; it will not be achieved until the industry is inspired as a whole by that spirit of confident adventure which animated the pioneers in Essex of whom the writer of the Memorandum speaks. This is not a counsel of despair: rather a message of hope for the future, and a seal of the past.

Modern Farm Machinery.—(D. N. McHardy, N.D.A., A.I.E.E., with preface by M. J. R. Dunstan, N.D.A., O.B.E. London: Methuen & Co., Ltd. Price 7s. 6d.) This work should prove useful both to farmers and students of agricultural engineering. Two opening chapters are devoted to the mechanical principles employed in farm machinery and to the materials and methods used in its construction. The author then deals at length with machinery and implements used on the farm and the main principles underlying their use. Subsoiling and rotary tillage have not been overlooked. A very useful chapter deals with the farm workshop, which is far too often neglected. The book is well illustrated and contains useful data regarding the utility and cost of operation of various machines taken from the reports of the Tractor Trials organised by the Society of Motor Manufacturers and Traders and investigations carried out by the Ministry during the last three years. An appendix contains various data of special value to the farmer who uses power.

The Agricultural Crisis, 1920-1923.—(R. R. Enfield. London: Longmans, Green & Co. Price 10s. 6d. net.) In this book Mr. Enfield has endeavoured to act the part of the unbiassed onlooker, and from the tangle of prejudice, misunderstanding and half-informed criticism that has passed for an explanation of agricultural events in this country in the last few years, has picked out the thread of truth, explaining the difficulties with which the British farmer has been faced. In clear language he deals with the broad aspects of the crisis, ignores details, which, however interesting, are not illuminating, and shows how monetary policy was at the back of the agricultural upheaval which took place between 1920 and 1923, not only in this country, but also in the United States.

The author takes for the basis of his argument the accepted fact that the depression in agriculture in this country has been caused by a violent overthrow of the normally existing balance between the prices of agricultural products and the cost of their production. Taking a series of years beginning with the period immediately before the War, he shows that the unbroken rise in the prices of agricultural produce up to 1919-20, and the fall which then set in, was not a phenomenon peculiar to this country, but was to be observed throughout Europe and America: that the upward and downward movement in the prices of commodities was not confined to agricultural products, but affected practically all articles of commerce: and that the fall in prices occurred almost at the same time in all parts of the world. With these facts to support him, he is able to demonstrate that the misfortunes of the British farmer were not due to the peculiarities of his particular market, nor to the effects of special legislation, but were the result of a cause that produced troubles equally in Great Britain and in California, in Poland and in Italy. This cause was the remarkable change during the period in question in the value or purchasing power of money: a change which was confined by no territorial limits, and which affected all commodities in the same way.

Inflation during the first part of the period improved prices, and produced a general feeling of prosperity: deflation at the end of the period brought prices down with a run, and was accompanied by severe depression in all markets. Mr. Enfield has much of interest to say with regard to the vexed question as to the extent to which the Governments of the more important countries concerned could, by a better monetary policy, have averted much of the trouble which the haste to return to the pre-war gold basis of currency occasioned, and this section of his book will be read with particular interest by those agriculturists who are interested in economics and financial questions. This part of the subject is dealt with in a particularly lucid manner, and technicalities which might obscure the argument in the eyes of some readers are successfully avoided.

After dealing with the cause of the crisis, and the effect of the crisis, the author goes on to indicate the lessons that can be learned from the experience that the critical years of 1920-23 have given to the farmers and the economists. He points out that it is the uncertainty as to the prices that will be realised by the farmer for his produce that cripples agricultural enterprise, and that no blessing would be greater from the farmers' point of view than the stabilisation of prices.

Orderly marketing, in Mr. Enfield's opinion, will do much to prevent extreme variations in prices, and he suggests that farmers and those interested in the framing of agricultural policy should concentrate their attention on the means by which orderly marketing can be achieved.

The book contains a number of well-drawn and interesting diagrams, and a special feature of it is the way in which American experience has been drawn upon to illustrate the arguments put forward.

* * * * *

REPLIES TO CORRESPONDENTS.

Effect of Ultra-Violet Rays on Plants.—G.K. asks what is the effect of the ultra-violet rays on the growth of plants, and on mildew and pests. This question was submitted to Dr. Bewley, Director of the Experimental and Research Station, Cheshunt, and his reply is as follows:—

Reply: (1) Past investigators have studied the effect of ultra-violet rays on the processes of growth and assimilation in plants, but their results have not reached the stage of practical application.

It has been shown that these rays retard growth and inhibit elongation in such plants as the begonia, lobelia, and potato. Also these rays appear to assist assimilation, and certain bacteria are destroyed by rays between wave lengths 2,960 and 2,100 Å.V.

So far as I am aware experiments on a practical scale have not shown conclusively that the growth of plants is improved, or that they are made more resistant to disease by means of ultra-violet rays.

(2) In order to test the effect of replacing ordinary glass by pure silica plates, it would be necessary to erect two small glasshouses, one glazed with ordinary glass, and one with fused silica. Any effect on

the crop would be seen immediately. I do not think that this has ever been done.

(3) The most suitable kind of glass for glasshouse construction is 21 oz. Belgian blown, in sheets 20 in. by 18 in. Fourth grade quality is used and is supplied in cases, each containing 80 sheets. The chemical composition, thickness and colour affect the quantity and quality of light transmitted, but you will find the glass recommended the most suitable for glasshouse work. (Information on this subject is given in a recent book by Dr. Bewley, entitled, "Diseases of Glasshouse Plants," published by Benn Bros., Ltd., 8, Bouverie Street, London, E.C.)

It is our intention to investigate the physical and physiological side of glasshouse construction at the first possible opportunity.

Sub-soiling with Explosives.—I.M. asks for information as to the breaking up with explosives of a "pan" formed under water-logged land.

Reply: Some trials carried out in the Cotswold Hills in 1912 are reported on page 79 of the *Scientific Bulletin of the Royal Agricultural College, Cirencester*, Nos. 4 and 5, 1912-13. The results were not very satisfactory, this being ascribed to the fact that the explosives brought the sub-soil to the surface. This seems more likely to occur when the soil is wet. Methods of operation are described in the *Agricultural Gazette of New South Wales* for May, 1913 (Vol. XXIV, p. 375), but in a later number of the same publication, December, 1918 (Vol. XXIX, p. 878), the State Department of Agriculture records its opinion that the cost is prohibitive and that "sub-soiling by explosives is not an operation which can be recommended in a general way." A Bulletin—No. 209 (1915)—of the Kansas Agricultural Experiment Station is unfavourable to the use of dynamite on heavy clays but admits its efficacy in the case of true "hard-pan." Speaking generally, the Ministry would not recommend the use of explosives, under ordinary conditions, in preference to the usual methods of sub-soil ploughing.

Further information as to the use of explosives might be sought from Messrs. Nobel, Buckingham Gate, S.W.1, who issue a pamphlet on the agricultural uses of explosives.

Shoddy and Silk Waste.—H.L. asks for particulars of experiments with shoddy wastes, wool and silk wastes, and seed cake as manure.

Reply: Results of trials in the use of shoddy are given in this *Journal* for March, 1915, page 1087, and in "Soils and Manures," by Sir John Russell, page 199 of the latest edition.

Silk waste is stated, on page 917 of this *Journal* for January, 1924, to be fairly rich in nitrogen (8-10 per cent.) but to be rather slow in action. This statement occurs in a review of Bruttini's "Uses of Waste Materials" and is repeated from that book. Probably, however, it should act rather better than shoddy; it is richer in nitrogen, and as a rule the richer substances are in nitrogen the better and quicker they act.

The Ministry is not aware of any English experiments with seed cake. An article on the subject by Dr. M. Rindl, Professor of Chemistry, Grey University College, Bloemfontein, appeared on page 628 of the *South African Journal of Industries* for December, 1923.

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Sturges, A. M.—Practical Bee Keeping. (328 pp.) London: Cassell & Co., 1924, 10s. 6d. net. [63.81.]

Engineering.

Hardy, D. N.—Modern Farm Machinery. (235 + xviii pp.) London: Methuen, 1924, 7s. 6d. net. [63.17.]

Robb, B. B., and Behrends, F. G.—Farm Engineering. Vol. 1. Farm Mechanics. (470 pp.) New York: John Wiley; London: Chapman & Hall, 1924, 12s. 6d. (62.)

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Evans, I. L.—The Agrarian Revolution in Roumania. (214 pp.) Cambridge: University Press, 1924, 12s. 6d. [333.5(4); 63(4).]

Horticulture and Fruit Growing.

Rhode Island Agricultural Experiment Station.—Bulletin 195:—On the Amount of Stable Manure Necessary for Vegetable Growing. (16 pp.) Kingston, 1923. [63.511.]

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California Agricultural Experiment Station.—Bulletin 373:—Pear Pollination. (86 pp.) Berkeley, 1923. [63.41(08).]

Plant Diseases.

U.S. Department of Agriculture.—Department Bulletin 1210:—Summary of Literature on Bunt or Stinking Smut of Wheat. (43 pp.) Washington, 1924. [63.24.]

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Southdown Sheep Society.—The Southdown Sheep. (95 pp. + 15 plates.) Chichester, 1924, 3s. 6d. net. [63.631.]

Texas Agricultural Experiment Station.—Bulletin 311:—The Influence of Individuality, Age, and Season upon the Weights of Fleeces Produced by Range Sheep. (45 pp.) Brazos County, 1923. [63.631.]

National Council of Pig Breeders and Pig Feeders.—Bulletin 2:—The Effect of Feeding Fish Meal to Pigs in the Production of Bacon. (8 pp.) London, 1924. [63.64: 043.]

Dairying.

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International Institute of Agriculture.—Le Lait et ses Dérivés: Renseignements Statistiques sur leur Production et leur Mouvement Commercial. (145 pp.) Rome, 1924, Fr. 15. [63.7(00).]

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Field Crops.

- Crops for Ensilage, *A. W. Oldershaw*. (Jour. Roy. Agr. Soc., England, vol. 84 (1923), pp. 39-49.) [63.19832.]
- Experiments with Cereals in Norfolk, *C. Heigham*. (Jour. Roy. Agr. Soc., England, vol. 84 (1923), pp. 166-173.) [63.3.]
- The Laying Down of Land to Grass, *W. Somerville*. (Jour. Roy. Agr. Soc., England, vol. 84 (1923), pp. 11-28.) [63.33(a).]

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- Potato Leaf Roll and Degeneration in Yield, *T. Whitehead*. (Ann. App. Biol., vol. xi, No. 1, April, 1924, pp. 54-72.) [63.23.]
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- Beef Production, *T. B. Wood*. (Jour. Roy. Agr. Soc., England, vol. 84 (1923), pp. 60-72.) [63.62; 043.]
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- The Merits of Home Produced Foods for Pig Feeding, *C. Crowther*. (Jour. Roy. Agr. Soc., England, vol. 84 (1923), pp. 174-193.) [63.64; 043.]
- The Value of Green Food for Fattening Pigs, *E. J. Sheehy*. (Jour. Dept. Agr. and Tech. Instr., Ireland, vol. xxiv, No. 1, May, 1924, pp. 28-41.)

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- The Manufacture of Blue-Veined Cheese, *L. J. Lord*. (Jour. Brit. Dairy Farmers' Ass., vol. xxxvi (1924), pp. 90-98.) [63.736.]
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- Various Types of Silos, *A. W. Oldershaw*. (Scottish Jour. Agr., vol. vii, No. 2, April, 1924, pp. 142-151 + 8 plates. [694.]
- The Economic Adjustment of Air Space in Cow Sheds, *W. G. V. Glossop*. (Jour. Roy. Agr. Soc., England, vol. 84 (1923), pp. 73-78.) [63.6; 69.]

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- How to Adapt Methods of Farming to the Changed Conditions of Agriculture, *James Wyllie*. (Jour. Farmers' Club, April, 1924, pp. 39-60.) [338.1.]
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NOTES FOR THE MONTH.

A PRELIMINARY statement of the Acreage under Crops and Grass, and Number of Live Stock in England and Wales in 1924, compiled from the annual agricultural returns collected on 4th June, was issued by the Ministry on 8th August, and appears on pp. 593-5 of this issue of the *Journal*. The statement shows that, compared with last year, the arable area has fallen by 253,000 acres, while that of permanent grass has increased by 183,000 acres, and there is also an increase of 56,000 acres in the area of rough grazings. The area under corn is about 110,000 acres less than last year, the decrease being accounted for by wheat. Oats, mixed corn and peas show appreciable increases. Potatoes and roots were grown on reduced areas, as also were clovers and rotation grasses, but most of the minor crops were more largely grown than in 1923.

The number of horses on agricultural holdings has fallen by 49,000, but all other classes of live stock have increased. The number of cows and heifers is 48,000 more than last year's record figure and the number of calves is 78,000 more. Sheep number about 1,000,000 more than in 1923, and the increase in the number of pigs is remarkable, bringing the total to 3,227,000, or 448,000 above the largest number returned in any previous year.

* * * * *

THE principal provisions of the Agricultural Wages (Regulation) Act, 1924, which received the Royal Assent on 7th August, are explained in the following notes.

Agricultural Wages (Regulation) Act, 1924.

The purpose of the Act is to "provide for the Regulation of Wages of Workers in Agriculture," and this is to be carried into effect by means of the establishment of local Agricultural Wages Committees and a central Agricultural Wages Board. These

bodies will supersede the Conciliation Committees established under the Corn Production Acts (Repeal) Act, 1921. The operation of the Act is confined to England and Wales.

Agricultural Wages Committees.—In the first instance a Wages Committee is to be established by the Minister of Agriculture and Fisheries for each administrative county (other than London) in England and Wales, except in 15 cases where two counties are to be combined to form one Wages Committee area. Thus, 47 committees are to be established forthwith, but the number may be increased or reduced at the request of the committee or committees concerned. Each committee is to consist of representatives of employers and workers in agriculture in equal proportions, of two impartial members appointed by the Minister, and of a chairman appointed by the committee. The method of appointment of the representative members is to be laid down by the Minister in Regulations to be made under the Act, and he may also appoint the chairman if the committee fails to do so within a given period.

Agricultural Wages Board.—The Minister is also required to establish an Agricultural Wages Board for England and Wales. This body is to consist of representatives of employers and workers in agriculture in equal proportions, and of a number of impartial members appointed by the Minister. The latter are not to exceed in number one-quarter of the total membership of the Board, and one of their number is to be appointed by the Minister as chairman of the Board. As in the case of the Agricultural Wages Committees the Minister is to decide the method of appointment of the members.

In the case both of the Committees and of the Board provision is made for the reimbursement, on a scale to be approved by the Treasury, of expenses incurred by members in attending meetings of those bodies.

Minimum Rates of Wages.—The principal purpose for which the Wages Committees and the Wages Board are established is to fix minimum rates of wages for all classes of workers employed in agriculture. Such rates when fixed will have the force of law. The Act requires that in fixing rates the Committees shall, so far as practicable, secure for able-bodied men wages which are “adequate to promote efficiency and to enable a man in an ordinary case to maintain himself and his family in accordance with such standard of comfort as may be reasonable in relation to the nature of his occupation.” It is further provided that the rates may, at the discretion of the body fixing

them, be such as to apply to all agricultural workers, or to a special class of workers or to a special district, and that regard may be had to the varying conditions of the employment of the worker, *e.g.*, as to whether employment is by the day, week, month, etc., or according to the number of working hours. The committees are also empowered, if they think it desirable, to fix differential rates of wages for overtime employment. In fixing minimum rates of wages the committees are required, as far as is reasonably practicable, to secure a weekly half-holiday for workers.

The power and duty of fixing minimum rates of wages rest primarily with the Agricultural Wages Committees, which have also the power of cancelling or varying any rates previously fixed. At least fourteen days' notice must be given of any rates which they propose to fix, and any objections to the proposal lodged within that period must be considered before a final decision is arrived at. When this procedure is completed the committee must forward its decision to the Wages Board, which is charged with the duty of making an Order embodying that decision, and specifying a date, subsequent to the date of the Order, from which the rates become operative.

The Wages Board itself may only fix, cancel or vary minimum rates in the following circumstances:—

- (1) When a wages committee has failed to fix a rate within two months of its establishment;
- (2) When a wages committee fails to fix a rate in substitution for one which has lapsed or has been cancelled;
- (3) At the request of the representative members of a wages committee.

The Minister has no power to fix, cancel or vary any minimum rates or to require a wages committee or the Wages Board to do so, but he may direct a wages committee to reconsider any rate which they have fixed.

Other Duties of Agricultural Wages Committees.—*Piece-rates.*—In addition to fixing minimum rates of wages for time work, the committee may, if they consider it desirable, fix minimum rates of wages for piece work. If, however, they do not fix such piece rates, it is open to any agricultural worker who is employed on piece work to complain to his committee that the rate at which he is being paid is insufficient to provide, in the case of an ordinary workman, a wage equivalent to that which he would earn at the minimum time rate fixed by that committee. On receipt of such a complaint, and after giving the employer an opportunity to state his case,

the committee may direct the latter to pay to the worker such sum as they consider is due to the worker by way of arrears of wages. Any sum so ordered may be recovered by the worker as a civil debt.

Permits of Exemption.—The committees also have power, in the case of any worker who is incapable by reason of “physical injury or mental deficiency, or any infirmity due to age or to any other cause” of earning the minimum rate applicable to his case, to grant him a permit exempting him from the minimum wage provisions of the Act. A committee may, if it so wishes, specify in the permit a rate of wages which is less than the general minimum rate, and any rate so specified becomes the minimum rate in respect of that worker, and failure to pay such rate renders an employer liable to proceedings as in the case of the ordinary minimum rate.

Allowances in Kind.—Agricultural Wages Committees must, if so required by the Minister by means of Regulations, define the benefits or advantages which may be reckoned as part payment of wages in lieu of payment in cash, and the values at which they may be reckoned for that purpose. Should a dispute arise with regard to such payments in kind a wages committee may give a decision, which is binding on the parties concerned.

Enforcement of Minimum Rates.—An employer who fails to pay to any agricultural worker in his employment wages at the minimum rate applicable to him renders himself liable not only to action in the civil courts for the recovery of the deficit but also to proceedings of a quasi-criminal nature. In the latter case he is liable, in addition to the payment of arrears of wages, to be fined up to £20 (twenty pounds) for each offence and in addition up to £1 (one pound) for each day on which the offence continues after conviction. Where such proceedings are taken the onus of proof rests with the employer, who must satisfy the court that payment has been made at not less than the minimum rate. Employers’ agents as well as employers personally are liable to prosecution for infringements of the Act.

Effect of Minimum Rates on Existing Agreements.—Any agreement for the payment of wages at less than the minimum rate applicable under the Act, or for refraining to exercise any right of enforcing payment at such rates, is null and void. On the other hand the Act does not prejudice the operation of any agreement or custom for the payment of wages at a rate higher than the minimum rate fixed under the Act.

Appointment and Powers of Officers.—The Minister is empowered to appoint a secretary for the Agricultural Wages Board and a secretary for each Agricultural Wages Committee as well as officers for the purpose of investigating complaints and securing the proper observance of the Act.

Such officers are empowered to require the production of wage sheets and other records of wages, to enter premises for the purpose of making investigations under the Act and to require any worker, employer or agent to give information with regard to the worker's employment or wages. It is an offence under the Act to hinder an officer in the exercise of his powers, to refuse to produce documents or give information for which he is entitled to ask, or to produce false documents or give false information. The duties of officers also include the taking of proceedings in the courts against employers who fail to pay the minimum rates.

Definition.—For the purpose of the Act the expression "agriculture" is defined as including "dairy-farming and the use of land as grazing, meadow, or pasture land or orchard or osier land or woodland or for market gardens or nursery grounds."

Regulations.—As required by the Act the Minister, on 12th August, gave notice of the Regulations which he proposes to make with regard to the constitution, procedure and powers of the Agricultural Wages Committees and the Agricultural Wages Board. These draft Regulations provide that the representative members of the Committees and the Board shall be nominated, in the case of employers by the National Farmers' Union, and in the case of workers by the National Union of Agricultural Workers and the Workers' Union. A period of forty days must elapse before the Regulations can be made and action taken under them, and during that period any representations with regard to them may be made to the Minister in writing by any public body interested. Copies of the draft Regulations may be obtained on application to the Ministry.

* * * * *

THE Council of the National Institute of Agricultural Botany have offered for sale this autumn approximately 2,500 quarters

**The New Wheat,
Yeoman II.**

of the new seed wheat, Yeoman II, bred by Professor R. H. Biffen, F.R.S., of the Cambridge University Plant Breeding Insti-

tute. The seed will be sold to farmers only through the trade, and tenders were invited from members of the Agricultural Seed

Trade Association, the National Association of Corn and Agricultural Merchants, the National Association of British and Irish Millers, and other established dealers in seed corn. On p. 419 of this *Journal* last month it was stated that among the new wheats available this season is Yeoman II, which was described as "similar to Yeoman in general characters and milling properties, but promising a higher yield." It is regretted that this scarcely represents the true facts, which are that the yields of the two wheats are approximately equal, but Yeoman II is superior to the old Yeoman wheat for milling purposes. It is very desirable that farmers should know how they are to identify genuine Yeoman II, and this is explained below.

Yeoman II is being introduced to take the place of the older Yeoman wheat. There are two substantial reasons for adding yet another sort to the list of wheats now grown in this country. One of these is that pure stocks of the older Yeoman, owing to admixture with other wheats, are getting difficult to obtain; and the second that Yeoman II is a better wheat.

The two Yeoman types are products of the same cross, namely, Browick x Red Fife. As seen growing in the field both show the same characteristic "dead level" appearance, owing to the fact that all of the ears reach to much the same height, both have the same sturdy straw which has proved so important a feature in carrying the large crops of grain which the older Yeoman has produced under intensive cultivation, and the cleanly foliage and stems show that the yield is not likely to be seriously diminished by the attacks of the common yellow rust. But useful as such appearances are as a general guide, they do not prove that Yeoman II should replace the older Yeoman. Where good sorts are being compared only a thorough series of trials can show whether one is better, on the whole, than another. The results of such a series are now available.

The yielding capacity of Yeoman II was tested out first of all by the Plant Breeding Institute on both gravel and clay soils on its farm at Cambridge. It was then tested at ten centres in different parts of the country by the National Institute of Agricultural Botany. These trials, which have been some of the most searching and accurate yield-tests yet made, show that the yielding capacity of Yeoman II is fully equal to that of the older Yeoman wheat. The grower of the new form can therefore rely on obtaining crops as satisfactory as those produced by the older one. But though the certainty with which heavy crops could be grown from the older Yeoman wheat was probably the chief

factor which led to its being so widely grown in a short period of time, the realization that there was always a demand for it amongst millers, even when other sorts were difficult to market, undoubtedly helped its spread.

The quality of the grain of the new Yeoman II has therefore been tested thoroughly. After chemical and physical tests in the laboratories at Cambridge had indicated that the quality was substantially better than that of the older Yeoman wheat large quantities of grain were grown on for comprehensive milling and baking trials. These were made by a special committee appointed by the National Association of British and Irish Millers. The greater part of the wheat they tested was from the crops grown at the ten centres already referred to in connection with the yield trials. It was produced therefore over as wide a range of soil and climatic conditions as would be met with in the wheat growing portions of this country. In the report made by this Committee is the following statement: "The bread by long or short baking processes is extraordinarily good of the so-called 'home-made' or 'farm-house' type. Its good flavour is remarkable, its bloom excellent, its crust first-rate of a rich brown colour. On these lines it surpasses anything we have tested for many years, and is incomparably superior to anything obtainable from average ordinary English wheat."

This opinion is based on the crops grown under the unfavourable climatic conditions of the year 1923. The analyses made that year by the Plant Breeding Institute indicate that some factor, possibly the lack of sunshine during the period when the grain was filling, had adversely affected the quality of wheat not only in the case of the new Yeoman II, but of all of the wheats under examination. It is therefore not unreasonable to expect that under more favourable conditions even better results will be secured. That this will happen seems almost certain, for in a series of tests made on the 1921 crop, Dr. Humphries obtained dough from the flour of Yeoman II of great elasticity and tenacity, and loaves approximating closely to those made from "No. 1 Northern" Manitoba wheat.

From the different points of view of growers, millers and consumers, Yeoman II should take the place of the older form.

The chief characteristics of the new wheat are: A clean healthy straw of medium height and good standing capacity; beardless white-chaffed ears of medium size when grown under average field conditions, squarely built but slightly less compact than those of Square Head's Master; grain long, red, and as a rule trans-

lucent; flour lively and granular, the behaviour of the grain in milling resembling that of the parent Red Fife.

Yeoman II, like the original Yeoman, is particularly suitable for growing on medium and heavy soils which are in good heart, and is specially recommended for the Eastern, Midland, and Southern Counties of England. It responds to good treatment and gives the best results when sown early. The Council of the Institute believe that farmers who intend to grow wheat under such conditions cannot do better than sow Yeoman II.

The attention of farmers is particularly drawn to the fact that genuine seed of Yeoman II can only be obtained in sacks closed with the seal of the National Institute of Agricultural Botany, thus :—



The price to farmers will be £6 6s. per $4\frac{1}{2}$ cwt. (i.e., per quarter of 504 lb., or 8 bushels of 63 lb.).

* * * * *

THOUSANDS of bushels of wheat are lost annually in England through neglect to pickle seed wheat as a protection against bunt. Most farmers know this, though

Prevention of Bunt in Wheat.

they do not all take measures to prevent loss. Infection of a crop is almost certain if seed contaminated with the spores is sown. When a crop is thrashed many of the bunted grains burst, and the healthy grains become coated with the minute black spores. Winnowing may remove unburst bunted grains and broken fragments of them, but it cannot free the grain from adhering spores. Grain may also become contaminated by spores from thrashing machines used previously to thrash an infected crop; while dirty sacks have been known to contaminate seed corn placed in them.

When the seed is sown both the grain and the bunt spores germinate, and the fungus invades the seedling wheat plant before it appears above ground, growing with it and maintaining itself near the growing tip of the plant. Later it finds its way into the young grains in the ear, eventually producing

a softish stinking mass of black spores covered by the skin of the grain.

The pickling of seed wheat with diluted formalin has been found reliable as a preventive. The Ministry recommends the use of this, the strength being at the rate of 1 pint of formalin to 40 gallons of water. Details of the treatment are given in Leaflet No. 92, obtainable from the Ministry.

* * * * *

FROM the beginning of October next the Ministry has arranged with the British Broadcasting Company to issue from their headquarters in London a regular fortnightly bulletin containing information designed mainly to assist and interest agriculturists and others concerned in the land and its cultivation. About 15 minutes will be taken up by each fortnightly message, which will deal briefly with the main tendencies of the chief markets, will offer observations on such matters as the methods employed in current agricultural practice and will include a short talk on some special seasonal topic. This talk will be prepared with a view to its being of interest not only to the agriculturist, but to others of the larger public who live in the towns.

* * * * *

THE past few weeks have witnessed two important events concerning agricultural co-operation in this country. One is the conference on "Agricultural Co-operation in the Empire" at the British Empire Exhibition, under the auspices of the Horace Plunkett Foundation, and the other the Annual Meeting of the Agricultural Organisation Society, at which a Resolution was passed instructing the Governors to wind up the general work of the Society. The juxtaposition of these events is fortuitous and carries no intrinsic significance; yet each may exercise a very far-reaching influence on the future of agricultural co-operation in this country.

The Wembley Conference afforded a valuable and long overdue opportunity for the interchange of views and experiences regarding the principles and practice of agricultural co-operation between those associated with the movement in these islands and the representatives from overseas. Of the various forms of co-operative endeavour to which the conference devoted its attention, the problems associated with the co-operative marketing

and the representatives from overseas. Of the various forms of regarded as the most important. The addresses delivered by the Dominion representatives on this question were both illuminating and impressive, and showed the high pitch of economic organisation which has been attained amongst farmers in their respective countries. The conference at Wembley has indeed, only emphasised what has been becoming increasingly clear in the last few years, namely, that the relation of producers overseas to their markets is undergoing a profound change. The overseas producers appear to be firmly convinced that, in the sale of their produce, they must, in some manner, have the advantage of mass selling which is enjoyed by every other industry, and, further, that they can only attain that advantage co-operatively. It is true that the Dominion representatives spoke of supplementing, rather than of competing with, supplies produced here at home, but it is clear that so long as the system of selling in this country is essentially competitive, large-scale operations designed to improve the efficiency and effectiveness of the machinery for marketing overseas' supplies in this country may have important reactions in the home-market which the British farmer will sooner or later have to face. Pertinent examples of what organisation has been able to effect will be found in the speech made at Wembley by the Hon. Charles A. Dunning, which is reprinted slightly reduced at p. 530.

It is important that the disappearance of the Agricultural Organisation Society should not connote a cessation of effort in the direction of organising the farmers of this country for their own benefit. Indeed, consistent with the march of events, the agricultural co-operative movement cannot and will not stand still. There is, however, important work to be done, which may well call for the intervention of a body more widely representative, and more powerful in its influence than the Agricultural Organisation Society could ever hope to be. The advocates of dissolution at the meeting of the Agricultural Organisation Society were under no delusion in this respect, and were of opinion that a way should be found to carry on the torch which the Society had so honourably lighted.

The Government, as is now well known, recognises the great importance of the economic organisation of the agricultural industry, especially as regards the marketing of produce, and, through the Ministry of Agriculture, is prepared to advance money on favourable terms to co-operative enterprises organised mainly for that purpose.

In addition, the Agricultural Credits Act provides facilities which will enable agriculturists who will co-operate for that purpose to obtain credit to meet such expenses as the purchase of seeds, fertilisers, feeding stuffs, etc. Much is also hoped from the careful and intensive survey which the Ministry of Agriculture is about to undertake of the whole region of marketing and its associated problems. These are important aids, which should facilitate such constructive work as may, in future, be put in hand by farmers themselves.

* * * * *

THE Government's proposals in respect of the sugar beet industry, as recently announced by the Chancellor of the Exchequer, are briefly as follows:—A direct subsidy will be given from the Exchequer on sugar produced from home-grown beet, to the amount of 19s. 6d. per cwt. for four years, including the present year, then 13s. per cwt. for three years, and 6s. 6d. per cwt. for a further three years. The Excise duty, from which the home producer is at present exempt, will be reimposed. The net effect of these proposals will be to give the home sugar industry a total advantage of 21s. 5d. over foreign imported sugars, instead of 11s. 8d., as at present; an advantage which can be very little affected by any further reduction in the sugar duty. The industry will now know exactly what it will receive by way of State assistance over the whole period of ten years, and, with the removal of any uncertainty as to the future, the factor which has, up to the present, been largely responsible for retarding the development of the industry will disappear.

The Government consider that, with this assistance, the manufacturers should be able to pay the farmer during the first four years of the subsidy period not less than 44s. a ton for beet of 15½ per cent. sugar content delivered to a factory, and this condition will be attached to the subsidy. In actual fact it should be possible with sugar at its present price for a good grower to earn at least 50s. a ton for his beet under the contract system which is in force at existing factories, and he would benefit by any rise in the price of sugar. With a fixed minimum price the farmer will be insured against a serious fall in the price of sugar, and the inexperienced grower will be able to reckon on a sufficient return during the period in which he is learning how to increase his yield and improve the quality of his crop.

THE PRACTICAL AIMS OF THE DAIRY FARMER.

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THE chief practical aim of the dairy farmer must of necessity be the same as that of any other business man who invests his capital in some form of industry, namely, the obtaining of the largest average net profit over a period of years.

This aim can only be realised by good all-round management, and farm management includes many operations of very diverse character, such as purchase of livestock, feeding stuffs, manures, etc., of the kinds most suitable for the farm in the most economical manner; efficient organisation of labour; selection of the most suitable crops, followed by adequate cultivation and good judgment at harvesting; wise use of home-grown and purchased foods; careful treatment of all kinds of livestock, and the sale of milk, dairy produce, surplus stock and crops in the most advantageous manner.

The second practical aim of the dairy farmer must, therefore, be successful management of those branches of the farm organisation which contribute most largely to the annual expenditure and the annual receipts. It is difficult to arrange these branches in a generally accepted order of importance, and fortunately this is not essential; some stand out clearly as absorbing major portions of the annual payments—*e.g.*, purchase of feeding stuffs, manures and seeds, occasional purchases of in-calf heifers and cows, and expenditure on labour; others are equally definite as the chief contributions to the annual income, *e.g.*, sale of milk and dairy produce, surplus livestock and surplus crops. In addition to the actual buying and selling, there is the important work of using the commodities purchased in the most advantageous manner for the production of the goods to be sold. This article will, therefore, be devoted to a brief consideration of the aims of the dairy farmer in each of the above-mentioned branches of farm management.

Purchase and Use of Feeding Stuff.—Numerous investigations have shown that the cost of purchased feeding stuffs is one of the largest items in the cost of milk production, hence the need for careful study of the composition and nutritive value of available cakes and meals in relation to price and

suitability for use along with home-grown foods. The aim of the farmer should be to provide a balanced ration of suitable foods at the minimum cost. The home-grown foods—hay, straw, roots, silage, cereal grains, beans, etc.—usually constitute the bulk of the ration, and purchase of other foods must be made in accordance with the supplies already on the farm. Space does not permit of a detailed discussion here of the principles and practice of feeding, but every dairy farmer ought to have for easy reference,* information on (a) the composition of feeding stuffs; (b) the work done in the animal body by the different constituents—albuminoids, oil, etc.; (c) at least one method of valuing feeding stuffs according to their analysis; and he should also be familiar with the so-called feeding standards for milk production which specify the quantities of food needed to maintain the dairy cow in ordinary condition and to produce a given quantity of milk. The use of these feeding standards, combined with a knowledge of the composition of feeding stuffs has given excellent results in the compounding of rations and in lessening the cost of milk production in many countries.

One instance of the value of such knowledge may be given. In the early winter of 1923 two of the cheapest feeding stuffs on the market were rice meal (£7 per ton), and extracted undecorticated ground-nut meal (£6 15s. per ton). Reference to the analysis of these foods showed that the former contained: albuminoids 13 per cent., oil 13 per cent., and carbohydrates 50 per cent.; starch equivalent, 72. The latter contained: albuminoids 32 per cent., oil 2 per cent., and carbohydrates 22 per cent.; starch equivalent, 45.

When mixed in equal proportion by weight, the mixture contained $22\frac{1}{2}$ per cent. albuminoids, 7 per cent. oil, 36 per cent. carbohydrates, with a starch equivalent of 58.5, and cost £6 17s. 6d. per ton. A further study of tables of food compositions showed that the percentage of digestible albuminoids would be about 17, and this percentage, with a starch equivalent of 58.5, would give a fairly well balanced mixture for milk production; one, in fact, which would fit in very well with an average maintenance ration of home-grown roots and hay. With regard to price, comparison with other feeding stuffs showed that, with two exceptions, the above-mentioned mixture was obtainable at a price per ton appreciably lower than any other single food or mixture of foods of similar composition on

* Miscellaneous Publication No. 32 (*Rations for Live Stock*), obtainable from the Ministry, Price 6d., post free.

the market; in fact, numerous other foods with similar percentages of albuminoids and oil were quoted at £9 or thereabouts per ton. The exceptions just referred to were palm kernel (extracted) meal, and palm kernel cake. A glance at the composition of these foods, however, showed that either of them could be used in equal proportions along with the rice meal and ground nut meal and the resulting mixture would still be well balanced for cows in milk; for example:—

			<i>Albuminoids</i>		<i>Oil</i> <i>Total</i>	<i>Carbo-</i> <i>hydrates</i> <i>Total</i>	<i>Fibre</i> <i>Total</i>	<i>Starch</i> <i>Equiv.</i> <i>Total</i>
			<i>Total</i>	<i>Digest.</i>				
Rice Meal	...	...	13	7	13	50	7	72
Undec. Extr. Ground								
Nut Meal	...	...	32	27	2	22	24	45
Extr. Palm Kernel Meal			19	16	2	49	16	71
Mixture	...	...	21.3	16.6	5.6	40.3	15.6	62.6

The percentage of indigestible fibre in the above mixture is higher than is desirable for heavy milking cows, but for average herds a mixture of the above composition has been proved quite satisfactory. Other mixtures containing less indigestible fibre and consisting of more appetising ingredients could easily have been made up, but when the relative costs per ton were compared, the advantage on the side of the cheaper mixture was a strong argument in favour of its use, at least for the first three gallons produced per cow. Cows giving higher daily yields could be given a more appetising mixture for the gallons yielded over three per day.

The fact that in one season market prices of feeding stuffs should vary so much that one or two properly balanced mixtures can be obtained for fully £2 per ton less than other foods of similar analysis constitutes a very practical reason why dairy farmers should have a knowledge of the principles and practice of rationing for milk production. Consideration should also be given to the probability that feeding stuffs can be purchased more cheaply during the summer than during the winter, and it is certain that the price per ton can be cut somewhat when an order is given for a large quantity of one kind of food. There is a certain amount of risk in buying forward, but on the average the purchaser gains; it is usually possible to get sufficient information during the summer as to the trend of prices, and it is preferable to consider groups of alternative foods rather than individual varieties.

There is a wealth of evidence that the important point in a ration is the correct balancing of the albuminoids, carbohydrates,

etc., rather than the inclusion of any one or two particular foods, and the object of the farmer should be to purchase such foods as will give a properly balanced ration in conjunction with those grown on the farm.

The benefit obtainable by purchasing a large quantity of any food is fully appreciated by the large farmer, but this advantage can also be obtained by those farming on a smaller scale if they will agree to use the same foods and pool their orders. This can be done privately, but a large development of this principle should lead to the formation of a co-operative society to organise purchases on a still larger scale.

Purchase and Use of Manures and Seeds.—The amount spent annually by the dairy farmer on manures and seeds is as a rule materially less than the expenditure on purchased foods, and the importance of these items in the annual expenditure will naturally vary according to the proportion of arable and grass on the farm.

The principles governing the selection of manures for different soils and crops are now generally understood, and information on the current prices per unit is easily available as a guide to the farmer in the purchase of his requirements. It is nevertheless desirable to emphasise two points; firstly, the importance of obtaining manures of high grade and reliable quality, and, secondly, the comparison of the cost per unit when the railway carriage, cartage and cost of application is taken into account in addition to the first cost of the manure. For example, a grade of basic slag with 20 per cent. total phosphate may be quoted at 41s. per ton, equal to 2.05s. per unit, and a grade with 34 per cent. total phosphate at 63s. per ton, equal to 1.86s. per unit. These figures show only a slight difference in favour of the higher grade, but further consideration shows that 6 tons of the latter will supply as much phosphate as 10 tons of the former. The purchase of the higher grade, therefore, means a distinct saving in railway carriage and cartage, and in the cost of application per acre.

With regard to the purchase of seeds all that need be said here is to urge the importance of buying always clean seed of excellent quality.

Purchase of Heifers, Cows and Bulls.—From the point of view of the prospective dairy farmer the purchase of heifers and cows to constitute the foundation of a herd is of the greatest importance, and were this article written primarily for beginners, this subject would have received first consideration. On the

other hand a very large number of dairy farmers are able to maintain their herds by the introduction of home-bred stock and rarely purchase heifers or cows. Where such a course is possible it is in the writer's opinion the best method of maintaining a herd because of the possibility of improvement in milk yield and breed type from year to year, but this improvement will only be gained if great care is given to the choice of a stock bull. In breeding herds, therefore, one of the chief practical aims is the selection and purchase of a bull with a view to the breeding of heifers of greater milking capacity and of better type than their dams.

In the selection of heifers and cows for the commencement or maintenance of a herd, attention should be directed chiefly to the age, type, breeding (including if possible the milk records of the parents), and place of origin. Many dairy farmers prefer always to purchase first-calf heifers and this course has much to recommend it, because heifers purchased at or soon after calving give an immediate return for their keep, are usually healthier than older cows, and, should they prove unsatisfactory as milkers, they can be disposed of at a price which shows little or no depreciation on their original cost. The quantity of milk produced by a herd of first-calf heifers is not equal to that produced by a herd of mature cows, but the greater risk of a considerable depreciation in the value of the latter usually turns the scale in favour of the younger animals. Where second-calf cows can be purchased from a healthy herd, they may be preferred to first-calf heifers because they will give larger yields, and the shape and size of the udder and position of the teats can be seen better.

Milk recording has made great progress in recent years, but as yet records are not available in respect of the dams and grand dams of the great majority of heifers available for purchase, hence purchasers must depend on selection by external characteristics—conformity to breed type, size, constitution and healthiness, and potential milking capacity as denoted by udder and milk vein development. In this connection it is interesting to note that one of the American Agricultural Experiment Stations has recently published the results of a comprehensive study of the relative importance of the different milk yield "indicators" in the Jersey breed. The degree of correlation between the actual yield, as shown by lactation records, and the conformation of different parts of the body as measured by the marks awarded on a score card basis, was found to be

surprisingly wide; the most reliable indicators were found to be: (1) the milk veins, which should be large, tortuous, and elastic; (2) the hindquarters of the udder, which should be well rounded and well out and up behind; (3) the udder, which should be of large size and not fleshy; and (4) the body, which should be wedge-shaped with deep large paunch, legs proportionate to size and of fine quality. The same investigators, however, point out that the actual yield of milk as found in a seven-day period a few weeks after calving is *twice as accurate* an indication of the cow's ability to produce milk as any external features or "points" of the animal.

It is highly probable that these conclusions are also largely applicable to other breeds, and the value of milk records in the sale and purchase of dairy cattle is thus confirmed from another point of view. The purchaser of dairy stock is therefore less likely to be disappointed in his purchases if he selects stock privately from milk-recorded herds or from complete dispersal sales of such herds. He must, however, study the published records closely, remembering that information as to the milk yields, number of days in milk, and dates of calving for two or three successive years are a much more reliable basis for judgment than the yield for one year or lactation period only.

To the owner of an established dairy herd, the selection of a young bull is one of the most important practical points. The only true means of improvement of a herd is by breeding, and the test of improvement is that the home-bred heifers should be better animals and better milkers than their dams: the chief agent in this improvement must therefore be the bull. If we assume that the dairy farmer on the look out for a young bull can be relied on to make a good selection on the basis of external appearance according to the points of the favoured breed, there are at least two other points which should be studied. The first is the dairy characteristics of the bull's dam and, if possible, his grand dams; these cows should be of good breed type, healthy, and with well-developed shapely udders and teats. The second point is the milk records of the dam and grand dams; these should be studied in detail as specified above in regard to the records of cows, remembering that an average of, say, 9,000 lb. over three successive years is a more valuable indication of constitution and milking properties than a one year's yield of 11,000 lb. to 12,000 lb. A third point which should be studied in some instances is the percentage of fat in the milk of the dam and grand dams. On this point there

will most probably be little or no information obtainable, but nevertheless there are good reasons why intending purchasers should persist in asking questions on this point. It is well known that as a rule (though fortunately there are occasional exceptions), heavy milking cows yield milk of less than average quality, hence the continued selection of bulls on the basis of milk yield only will tend to lower the average quality of the milk produced by the herd and increase the risk of trouble with the local authorities responsible for the administration of the Food and Drugs Acts. To many dairy farmers the main object is to get an increased yield from their herd, and if the use of a bull, the son of a heavy-yielding dam whose milk averaged only 3 per cent. of fat, would ensure an increase of 100 to 200 gallons per cow, they would take the bull and risk any trouble in respect of quality. There are, however, many others who have already high herd averages, and in such cases the quality of the milk should receive attention; buyers of milk are likely to have an increasingly wide field of producers to select from, and discrimination may be exercised to the disadvantage of those whose milk is troublesome in respect of quality.

Management of the Dairy Herd.—A dairy herd is kept for the purpose of producing milk, hence the management should include all those details which experience and research have shown to be advantageous and economical. Milk recording has proved its value in hundreds of cases as a means of improving the average yield and thus giving a larger sale of milk from the same number of cows with the same expenditure on labour and other overhead charges. Butter-fat testing in herds where the milk is made into butter or cheese has also shown how the output from the herd can be increased, and where young bulls are sold for stock purposes, information as to the fat percentage in the milk of the dam may enable a higher price to be obtained. Service and calving records should be carefully kept to enable cows to be dried off in preparation for the following lactation period, and times of service should be regulated so that cows will calve at the time when the maximum production of milk is most desirable or when it is most profitable.

All cows should be marked by tattooing or some other method so that they can be identified, and all calves reared for stock purposes should be similarly marked and a record kept of the tattoo number or markings so that they may be identified and their ancestry traced when necessary. Failure to mark calves

so that they can be identified later has caused numerous herd owners to lose many years in the grading-up of stock for registration in the Breed Herd Book. Milk Recording Societies, operating under the regulations of the Ministry of Agriculture, now undertake the tattooing of calves and keep the necessary records, and membership of one of these societies affords the easiest and most reliable means whereby records of milk yields, butter fat percentages, calving and service dates and the tattoo numbers of cows and young stock can be obtained. The cost of membership is not great and, though the farmer must at present consider carefully every item of expenditure, the money spent on milk recording and calf marking should be looked on as a good investment, for there is no doubt that in the course of time it will return a highly satisfactory rate of interest.

Another important aspect of herd management is the maintenance of a thoroughly healthy dairy herd—free from contagious abortion and tuberculosis, and with the minimum of udder troubles. Probably the most effective precaution which can be taken to prevent outbreaks of contagious abortion is to rear sufficient young stock to maintain the herd, thus making purchase of female stock unnecessary and to keep a bull for the herd. The same procedure is also very desirable when a tubercle-free herd has been obtained through the application of the tuberculin tests and elimination of reacting animals. In spite of the criticism still occasionally directed against the tuberculin tests there is a steady increase in the number of practical dairy farmers who are convinced that the application of the tests and action according to the results obtained is well worth while, because in addition to freedom from tuberculosis, herds of non-reacting animals are healthier in every other respect. With regard to udder troubles the chief precautions are close observation, immediate treatment of every affected quarter according to the nature of the trouble, isolation of the cow when necessary and particular attention to cleanliness in housing and milking.

In all matters affecting the health of a herd the advice and assistance of a veterinary surgeon should be sought without hesitation, and there can be no doubt that the circumstances are most favourable to successful treatment in herds of home-bred stock (where the life history of each animal is known), housed, fed, watered and milked under cleanly conditions.

Organisation of Labour.—On many farms the wages bill is the largest single item in the annual expenditure. The first

essential is to get one or more good men who understand the work of herd management and of land cultivation, and who are not afraid of responsibility. A good herdsman or head cowman is well worth good wages; if his duties and responsibilities be considered in detail it is at once realised that no expenditure by the owner of time and money in the selection and breeding or purchase of valuable dairy stock, or in the provision of model equipment can ensure success without the wholehearted co-operation of the men who feed, milk and attend to cows at calving time, deal with cases of udder trouble and the numerous other small but nevertheless important items in the management of a dairy herd.

The only school from which such men can be obtained is that of experience, and although occasionally it may be imperative to make a change in order to get a more reliable staff, as a rule the problem before each farmer is to consider what steps he can take to arouse a greater and more intelligent interest in their work on the part of the men he already employs.

Assuming that the farmer himself is keenly interested in the welfare of his herd and in all details of herd management, there are a variety of ways in which the interest of the men may be developed. The bonus system may be introduced in some suitable form and additional payments made on the basis of the number of calves born, or the number of cows attaining yields of 10,000 lb. of milk per annum or lactation period, or on the total output of milk. There are objections, however, to giving a bonus in connection with the usual duties of the cowmen or milkers. A good man should not and does not require special payment as an inducement to give a calving cow special attention, and where bonuses have been paid on a milk yield basis, instances have been known of the records having been inflated. At the same time the bonus system may be most helpful in some instances, for example, in the production of graded milk, where the amount of the bonus can be made dependent on the bacterial count. Success in clean milk production depends primarily on the manner in which the routine work of washing and sterilising utensils, cleaning cows and milking is carried out, and as the degree of efficiency in this work is determined by the bacteriological content of the milk, a bonus payable on such a basis is only paid when there is independent evidence that a high standard of work has been attained.

The introduction and development of milk recording has done much to improve herd management and to make the twice daily

task of milking more interesting. The daily or weekly weighing of the milk institutes a measure of progress and a basis of comparison which was previously lacking, and on many occasions the writer, when doing milk recording work has been struck with the interest shown by the milkers in the yields of different cows. Any suggestion which might mean an addition to the number of milk recording forms issued under the Ministry of Agriculture's scheme can only be made with great reluctance, but nevertheless a card, which should be kept in the cowshed, so ruled as to show the amount given each week and the total to date for each cow in the herd would be a handy record for the owner and would be greatly appreciated by the men. In many cases the milker knows the highest daily yields of the cows he milks, but is never informed of the total yield in a year or lactation period.

In respect of feeding much can be done by the farmer in selecting the kinds and quantities of foods which will give a suitably balanced ration, and in a system of feeding in relation to milk yield, but the giving of the allowances of concentrates, etc., at each meal, must be left to the cowman, and in the case of heavy milking cows there are times when it is most important to have a man who knows when to depart from the usual system; in other words, the man who actually feeds the cows has as much need for knowledge of the composition and effects of the different foods as the man who grows or buys them. Much can be done towards supplying this knowledge by distributing the Ministry's leaflets and Agricultural College bulletins on foods and feeding, but attendance at a lecture or course of lectures is much to be preferred. On several occasions when arranging the time of a lecture on the feeding of dairy cows, the writer has been asked to agree to an hour which would permit of the attendance of cowmen as well as farmers, and such meetings have invariably been well attended and followed by acute and interesting discussions. There is room for a wide development of this principle. The great majority of herdsmen and milkers are truly interested in their work, and a more extensive co-operation between the farmer and the County Agricultural Education Authorities with a view to providing short courses of instruction in dairying districts on such subjects as rationing of dairy cows, secretion of milk and milking, cleaner milk production and first-aid treatment in common diseases, particularly of the udder, will be very much appreciated and cannot fail to give the men a more intelligent understanding

of their work and ensure better management of the dairy herd.

Management in Relation to Sale.—*Milk.*—The chief product which the dairy farmer has for sale is milk, and the method of sale is to a great extent governed by the position of the farm in relation to a market. Where the farm is situated close to a large centre of population there are two alternatives: (a) to sell by retail direct to the consumer; (b) to sell wholesale to a retailer. Where the former method is adopted the farmer gets a higher price because he undertakes the work of distribution as well as that of production, and should get a profit on both branches. On the other hand the distribution of milk direct to the consumer's house requires great attention to detail, and may well be quite as worrying as the management of a herd of dairy cows. Provided that the farm is in a suitable position for the development of a retail business, it may well be that the deciding factor is the temperament of the farmer himself. To many it is sufficient to undertake the production side of the industry, and be content with the producer's profit; to others, including those in whom the business instinct is more highly developed, the probable extra profit is a deciding factor, and they undertake the labour and worry of the distributing side of the business in order to obtain this extra return.

Where the farmer is also the retailer he should make a study of the practical details of this business, including the organisation of delivery rounds to save as much labour as possible, the handling of milk to ensure uniform quality, the best mode of delivery—whether from a churn or by can or bottle—and the washing and sterilisation of all utensils to avoid the delivery of milk which will sour quickly. In addition he must master the art of maintaining good relations with his customers, and be ever on the look-out for new ones. If the supervision of these details cannot be undertaken by the farmer himself, he must employ an efficient manager who will be able to hold his own in competition with the man who is a retailer only and who is therefore able to devote his whole time to this work.

Generally, however, the dairy farmer is not a retailer of his own produce; he sells his milk wholesale, because the distance of his farm from a market leaves him no other practical alternative, or he makes it into cheese or butter on the farm. The price he receives is of paramount importance, but he has also responsibilities in the milking of the cows and handling of the milk, and the manner in which this work is done has a direct bearing on the trade value of the milk itself. No one will contend that milk which goes sour within twelve to twenty-four hours is worth

as much either to the distributor or the consumer as milk which will keep sweet for forty-eight hours or more, and it is therefore the business of the farmer to take all practicable precautions to produce a wholesome and good-keeping milk. The distributor and the householder must share the responsibility for the condition of milk up to the time it is used, but undoubtedly the farmer must take the first steps, which consist in seeing that the cows are cleaned before milking, that the utensils through which the milk passes are clean and sterile, that the milking is done in a cleanly manner, and that the milk is immediately cooled to as low a temperature as possible and kept cool and protected from heat and dust before, and, if delivered by the farmer, during conveyance from the farm. Much study has been devoted to the handling of milk on the farm in recent years,* with a view to discovering the simplest and most effective methods, and the latest information is easily obtainable on application to the agricultural educational authorities in each county, or the nearest agricultural school or college.

With regard to price, often there is little that the individual farmer can do to obtain a higher figure. The distribution of milk covers such a large series of operations from the farm to the consumer, and the quantity to be dealt with is so immense and yet so fluctuating, that large wholesale or retail organisations have grown up to undertake this phase of the business, and as these firms have also to deal with the seasonal surplus milk they are in a very strong position when negotiating on prices with a single farmer. The only way in which the farmer can hold his own is by co-operating with other farmers who also have milk to sell, and much has been done in this direction by the National Farmers' Union. The scheme of prices and quantities agreed on by the Committee composed of representatives of this Union and of all the distributors' organisations has proved quite workable and has helped greatly to stabilise the industry during the last two years.

Farmers must always remember, however, that the distributive or manufacturing sections of the industry will not purchase more milk than they can dispose of at a profit, taking one year with another, and that the fixing of a price by agreement for the country as a whole, with modifications according to areas, does not necessarily mean that there is a market for every individual farmer's milk. Milk production is undoubtedly increasing throughout the country: the purchase and use of milk

*Miscellaneous Publication No. 41 (*Studies Concerning the Handling of Milk*), obtainable from The Ministry, Price 1s., post free.

by the public must also increase, otherwise many producers may find that milk of the cleanliness and keeping quality which they produce cannot find a profitable market. It would appear therefore that it should be part of the practical farmer's policy to do all he can to increase the consumption and use of milk, and to take great care that the milk he himself produces is such that the purchaser will wish to drink and use more of it.

There is also the possibility of producing a higher grade milk which will command a higher price. Since 1915 licences to describe milk by special designations have been obtainable from the Ministry of Food, and later from the Ministry of Health, and the possessors of these licences have as a rule obtained a higher price for their milk. The question at once arises, "Is the increase in price sufficient to meet the increase in the cost of production involved in complying with the regulations under which such licences are granted?" In many instances the answer is undoubtedly—Yes. There is also an increasing amount of evidence that where, in order to obtain a Grade A (Tuberculin Tested) Licence, or a Certified Licence, an owner has eliminated all cows and heifers in milk which react to the tuberculin tests, the standard of health is definitely raised in the herd as a whole and losses are materially lessened.

Cheese and Butter.—Where the milk is made into cheese on the farm, the sale of the cheese is in the hands of the farmer. The price obtainable for English hard-pressed cheese is, however, influenced by the price of imported cheese, and where the home-made product is of second-class or inferior quality it is increasingly subject to very keen competition. The choicest qualities of the well-known English varieties have always commanded good prices, and will continue to do so; it appears obvious, therefore, that the farmer who makes cheese should do all he can to maintain and improve the quality of his product and also join with others interested in this branch of the industry in making known to the public the merits of English cheese, so as to increase the demand. It must, however, be recognised that advertisement will do more harm than good, unless the high quality and uniformity of the product can be assured.

In respect of butter, it is estimated that 32 per cent. of the milk produced in Great Britain is used for butter-making, but there is no doubt that in many districts this course is followed in order that the separated milk may be available for the raising of stock, rather than for the direct returns received from the sale of the butter. Numerous private dairies make butter of the highest

quality which is disposed of at a satisfactory price, but farm butter as a whole is so varied in colour, flavour and keeping qualities that it cannot have more than a local market. Where the quantity of milk to be made into butter is sufficient to provide a regular supply winter and summer, and no other outlet for the milk is available, then every effort should be made to produce butter of the best quality and to find a market amongst those who are prepared to pay an adequate price for a first-class home product.

Surplus Stock.—Little can be written which will help farmers in the sale of animals which are depreciating in value, and there are usually a few such in every dairy herd. On many farms where a breeding dairy herd is kept, however, it may well be worth while to rear a large proportion of the heifer calves, partly in order to have a larger number to select from for maintaining the herd and partly because there is usually a good demand for dairy heifers, either when fit for service or down calving. Surplus stock of this sort may be a valuable source of income, and if the milk records of the dam and sire's dam are good enough to be published, then the market price of good animals is further enhanced. There is also a steady demand for in-calf heifers and young cows which have passed the tuberculin test, and when animals of the right type and breeding are to be sold, their market value will be increased if they are offered for sale with certificates that they have passed the tuberculin tests required by the Ministry of Health for entry into Grade A (Tuberculin Tested) and Certified Herds.

Conclusion.—The chief practical aim of the dairy farmer was defined at the commencement of this article as the obtaining of the largest average net profit over a period of years. It was pointed out that this end can only be attained by good-all-round management in respect of purchases and sales, in utilisation of the land and other raw materials for production, and in the organisation of labour. Many points in such management have been discussed in detail above. It is now only necessary to emphasise that this does not mean a conservative stay-at-home policy. Interest, enthusiasm and personal attention to principles and occasionally some details on the part of the farmer himself are essential to good management, but it is also desirable that the farmer should take a judicious share in the farming activities of his district and in the work of the local Agricultural Society and the County Milk Recording Society; he should also visit experimental farms and well-managed farms in other districts

to see the methods which have brought success or failure there. In times like the present old methods must be réconsidered, new methods and suggestions studied and perhaps given a trial, and an open and inquiring mind must be joined with a determination to succeed.

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THE CO-OPERATIVE MARKETING OF FARM PRODUCE.

A CONFERENCE on Agricultural Co-operation in the Empire, convened by the Horace Plunkett Foundation, was held at the British Empire Exhibition from 28th—31st July. The subject of the co-operative marketing of agricultural produce was discussed on 29th July, when a speech was made by the Hon. Charles A. Dunning, Prime Minister of Saskatchewan, of which the following is a slightly abridged report:—

I believe I am this morning to address myself to the subject of The Co-operative Marketing of Farm Produce, with particular reference to what is being done in Canada, and especially in Saskatchewan, the province from which I come. If, therefore, I appear to talk very much of Canada and Saskatchewan I trust the impression will not be conveyed that we think we are perfect along these lines in that part of the world. That is not the case, in fact one of the main objects of this Conference so far as I am concerned is to learn from others in different parts of the Empire what they are doing in connection with co-operative marketing of agricultural produce, in order that we may, if possible, perfect our methods in Western Canada.

In Canada Government assistance in co-operative marketing was primarily directed along legislative lines; the various provinces have from time to time enacted legislation facilitating the formation of co-operative organisations of farm producers for marketing in some cases specific products; in other cases generally. I think I may say that every province in Canada has legislation facilitating co-operative organisation for marketing purposes among farmers.

The outstanding features of such legislation are, first, cheap, easy incorporation; second, standardisation of methods, and third, the ensuring that the organisation when created shall remain co-operative in spirit, and not become an ordinary capitalistic corporation dominated by a majority financial interest. In these organisations the man, the producer, counts

rather than the investment of the producer in the capital of the organisation. I think I may say that this is characteristic of the forms of co-operative organisation in all of the various provinces of Canada.

Another form of State assistance that is present in some of the provinces of Canada, and to a very great extent at times in Saskatchewan, is assistance by way of State management. I know State management of co-operative marketing does not sound very good at first blush, but the manner in which it has been conducted up to the present time has been markedly successful in placing upon their feet co-operative organisations for the marketing of specific farm products, whereas in all probability if they had been left to tread the thorny road of ordinary experience themselves, the organisations would never have lived through it.

It is characteristic of the co-operative movement wherever we find it that the first class of individual in connection with it is what I might term the co-operative evangelist, the enthusiast who is imbued with the idea, who sees fully the possibilities and who can arouse his fellows to organise. Usually, however, the evangelist is not the type of man to look after the practical business of co-operation once the organisation is established, and our difficulty is that we do not throw up enough men who have that capability of evolving from the evangelist, from the enthusiast, into the practical man of everyday business who is absolutely necessary for the successful management of any business whether co-operative or otherwise.

The principle in Saskatchewan with regard to State management is this—we have in the Department of Agriculture a branch known as the Co-operation and Markets Branch. Its object is to respond to appeals from one district or another for information respecting co-operative marketing possibilities in connection with any product of the farm. I do not mean to imply that the State is endeavouring to force co-operative organisation upon the farmers, or that the State is a co-operative propagandist, but rather that in the Department of Agriculture is an organisation which can give expert advice to any group of farmers who are imbued with the desire of co-operatively marketing any product. The work has been very successful, but the problem speedily arose, especially in connection with what I call the subsidiary products of the farm, that the products were not of themselves of sufficient importance in the

general scheme of things to warrant an organisation being created to handle them especially. For this reason the method was evolved that the Co-operation and Markets Branch of the Department of Agriculture would undertake to market that particular product for these farmers co-operating for the purpose, not as a permanent undertaking, but on the distinct understanding that as soon as the product assumed a sufficient importance in the eyes of those producing it and was produced in sufficient volume to allow it to be done, a co-operative organisation entirely composed of the farmer-producers should undertake the work of marketing at first done by the Branch of the Department of Agriculture. Of course this evolution is not always easy. Whenever a branch of the public service undertakes this kind of business, the tendency of the civil servant is to desire to improve the reputation of his Department, and it is difficult to wean the institution away from the Department on that account. Another reason lies in the fact that it is human nature apparently to lean upon the Government as long as the Government will let you lean upon them. By starting right in connection with two products which have since assumed very great importance in our agricultural production those difficulties have been overcome.

Wool in Saskatchewan was a subsidiary product some years ago, not considered as of any great importance in the general scheme of things. The Co-operation and Markets Branch commenced marketing wool co-operatively for farmers, gradually wool production increased, gradually the benefits of co-operation with respect to the marketing of it became known, and now for some three or four years the wool of Saskatchewan is marketed through the Canadian Wool Growers Co-operative Association. Just as soon as the commodity reached a stage where it was good business to establish a co-operative managed by the farmers themselves who owned the wool to handle that commodity, that was done and it has gone forward from success to success. The same is true with respect to the dairy business in the province; before the province was formed, when it was a part of the North-West Territory, the Federal Government established co-operative creameries managed by the dairy branch of the Federal Department of Agriculture. When the province was formed the Provincial Government had to take over the baby. It was not a desirable thing apparently from the point of view of the relationship of the State to co-operation, but the industry was in the developing

stage—dairying was not then of great importance to the farmer, he was in it one year and out of it the next, he could not be persuaded to pay the business attention to dairying that he paid to his “money crop.” The Government carried on the agreements for a number of years, and gradually by a process of education through the Dairy Branch of the Department, dairy production grew and about seven years ago the dairy farmers, said, “Now, we think we are ready to undertake the management of this enterprise ourselves”; and so the Saskatchewan Co-operative Creameries, Ltd., was formed (I will speak of the matter of financing a little later in another connection), and the farmers who produce the cream and who are the shareholders in the Saskatchewan Co-operative Creameries, manage their own business. They operate some 28 creameries and factories and have a very large business, also the dairy production of the province has increased enormously. There is another instance of co-operation in marketing a product being fostered in its infancy by a State Department, and later, on its attaining a stature sufficient to enable it to do so, being placed under the control of the producers themselves.

I do not know whether that experience is of any value to those from other parts of the Empire, but I may say that our experience leads us to the conclusion that we are prepared in Saskatchewan to continue the policy indefinitely. We are doing it now with potatoes. I do not know how long it will take before potatoes can be marketed co-operatively by an organisation of the farmers interested in growing potatoes, but I do know that judging by our previous experience it is the right line to take so far as our people are concerned.

Now, when I speak of State management I do not mean that the State is pap-feeding the industry by going into it. Every dollar of cost in connection with the State management of the co-operative marketing of a commodity in Saskatchewan is charged against the commodity; the producer must stand on his own feet in relation to the enterprise while the State is managing it in exactly the same way as he later must when he is handling it by a co-operative enterprise.

State Financial Assistance.—Now I come to State financial assistance, again a very delicate subject, because of that tendency of human nature to which I referred a little while ago. Personally, I know of nothing so deadening to co-operative effort as to have a fund

under the control of someone else from which you can draw to cover up and pay for the mistakes which you have made. I know of nothing so deadening to the up-building of co-operative organisations as the ability to get money from someone other than the co-operators, and it has been the ruin of many co-operative organisations. In connection with the creation of an organisation which requires to own and operate extensive facilities, the matter of providing capital for that purpose has always been a great problem to co-operators, because of the principle to which I referred a few moments ago, that the man counts and not his investment.

Co-operative Grain Selling.—In the early days in Western Canada we suffered a very great deal from what we called the grain monopoly. It was rather easy under the conditions prevailing there for a monopoly to be created; grain was handled in bulk through warehouses located only at the sidings of the railway companies, and naturally the organisation owning the facilities had a monopolistic opportunity which in those days at any rate was used to the fullest extent. Combination was easy to arrange because of the ownership of the warehouses, and naturally there were price agreements, grade agreements and all kinds of abuses. The farmers' organisations, especially the Saskatchewan Grain Growers Association, agitated with regard to this state of affairs, and it was decided to attempt to deal with the matter in Saskatchewan co-operatively on the general principle that if the farmers themselves owned the facilities, they would then dictate the manner in which their produce would be handled.

As a result the Saskatchewan Co-operative Elevator Company was formed for the purpose of dealing in grain. I was closely associated with the company from its inception, was in fact its first General Manager, and so I can speak with some confidence with regard to most of the important matters of principle connected with the organisation. First it was based upon central management with local advice with respect to local conditions. Each Local had a separate organisation for the purpose of representation at the annual meeting of the company. Each shareholder had one vote and no shareholder could hold more than 20 shares of a par value of 50 dollars, that is 1,000 dollars or £200 in English money, of the stock of the company. Each Local elected one of their number to represent them at the annual meeting, thus the number of delegates voting upon the matters at an annual meeting corre-

sponded with the number of locals of the company in existence. The transportation expenses and living allowance of the delegates to the annual meeting while away from home were paid by the company as a part of the cost of running the organisation, thus ensuring a full and interested attendance on the part of the representatives of the shareholders from all points in the province. At each annual meeting three directors are elected, to serve for three years, the full board thus consisting of nine directors.

The business of the company is to build elevators, operate them and generally engage in the business of grain marketing. Now, where does the Government come in? Elevators cost a great deal of money, and it was decided, after careful investigation, that provided the farmers in a locality subscribed sufficient of the capital stock of the company to cover the cost of the facilities which they required at their local point, and paid up in cash 15 per cent. of their subscriptions, the province should advance to the company the remaining 85 per cent. of the cost of erecting those facilities, taking as security a mortgage on the facilities themselves, and also a mortgage on the uncalled capital stock of the company. The relationship of the State to the institution, therefore, was that of first mortgagee on the facilities and first mortgagee on the uncalled capital liability of the individual shareholder. The repayment to the State was arranged on an amortised basis over 20 years with the understanding that the State would loan the money to the institution at a rate of interest not to exceed the cost of the money itself to the State, but the money has never been lent at a rate below the cost to the State, the idea being that there should be no contribution from the general taxpayer for the scheme, but rather that the credit of the province should be placed behind it, because of its vital importance to the welfare of all the people.

Well, that was done, and I will give some particulars of what has resulted. The shareholders now number 25,000. They have 425 country elevators, that means 425 local organisations of farmers, each of them grouped around the particular facility for handling their grain in which they are interested. The storage capacity of their country storage houses is 12 million bushels. In addition, as time went on, it was found necessary for the institution to own terminal elevators at the ports, to own appliances capable of treating damaged grain—hospital elevators, and they have at the present time over

6½ million bushels of capacity in terminal and hospital storage. In addition, last year they leased from the Canadian National Railway system owned by the Government of Canada, a large terminal elevator, I think the largest in Canada, of 7¾ million bushels capacity; so that they have at the head of the Lakes to-day 15,175,000 bushels of capacity for storing their grain, and out of a total capacity at the port of around 60 million bushels, 15 million bushels, or one quarter, is owned by the organised farmers, and operated by them.

You may ask about dividends, you want to know of course if the concern has been really co-operative. Well, in that regard, legislatively it may be, but as a fact the necessity of meeting the payments due to the Government from year to year, making provision for them, and making provision for the further extension of facilities at the ports, has prevented the payment of dividends. I want to show, however, that the industry as a whole is better off by reason of having the dividends kept in a lump and used to further the benefits of the institution by the creation of more facilities, than they would have been if the dividends had been distributed from year to year. The right, however, exists in the legislation for the institution to distribute profits co-operatively if and when it desires to do so; it is absolutely free in that regard. Up to the present, however, the necessity of developing further facilities has prevented any dividend. I might give some few figures showing what advantage has been gained.

The shareholders paid in 15 per cent. of the total subscribed capital of 4,422,000 dollars, about 700,000 dollars of actual cash, and the depreciated value of the assets of the institution is 6,647,000 dollars. Therefore, by the investment of their profits from time to time in further facilities and the repayment of indebtedness due to the Government, they have built up capital assets of 6,647,000 dollars from an initial cash investment of less than 700,000 dollars. The only creditor is the Government, and the amount unpaid, but not yet due, is about 2 million dollars. Since the inception of the institution in 1911 it has handled 335,000,000 bushels of grain, and this present season over 50,000,000 bushels of the Saskatchewan crop will pass through the co-operative system.

What has been the effect upon the industry? Has it been good? That is the most difficult thing to prove, the benefits to the individual in dollars and cents of co-operative marketing; if a co-operative raises its price to the producer

because the market warrants it, the competitor does the same; that is natural, that is business, and then of course he says to the co-operator, "Now, what good is this institution to you, I am paying the same price," but of course it is difficult to find out what he would be paying if the co-operative were not there. In the early days of the Institution it was possible to demonstrate this on some occasions, because we had only a few elevators to start with, and we were able to compare the prices being paid by our competitors at the points at which we had elevators and the prices paid by them at other points where we had not elevators, so in the early days it was fully possible to demonstrate the actual gain to the farmer. As the system extended and became represented at most points in the province naturally traders saw to it that this weapon was taken out of our hands. If our price list in the province of Saskatchewan generally is at a certain figure, one can rely upon it that the others will not be very far away. However, the farmers generally seem to be able to understand that the co-operative really compels the private trader to pay fair prices.

In regard to the relationship of the State, may I say this, that in 13 years the company has met religiously every dollar of its obligation to the province. A Government guarantee of credit was necessary in the earlier years, because of course the Government held all the security, there was no security to give to the bank except the commodity itself, and, of course, a margin was required. In those years a Government guarantee was given; for the last five years the concern has been able to get a larger credit than any grain concern in the Canadian grain business without one dollar of Government guarantee.

Dairy Co-operation.—Naturally, the success of that plan in relation to grain led us to consider the application of the same general principle with respect to other commodities, so when the creameries were turned over from State management to the management of a co-operative concern, it was organised on the same general principle as the Saskatchewan Co-operative Elevator Company. Thus, we have to-day the Saskatchewan Co-operative Creameries, Ltd., operating on the same general principle. I cannot point to the same record of unbroken success in regard to the creameries, but I am more hopeful about them now. Whatever difficulties have occurred were difficulties connected largely with the deflation in values of

dairy products during the years immediately following the War. I suppose there are many here who have experience in handling dairy products at a time when the slump came—I do not know if there was a slump in this country, but we had an awful one. While the creameries have been passing through a difficult time there is every reason to hope that their success from this time onward will be, as it was during the few years following its inception, equal to the success shown by the grain institution in relation to its business. One must remember that it is much easier to interest the farmers in co-operation in grain marketing in Saskatchewan than it is to interest them in dairying co-operation. Grain is the money crop, dairying is just getting into its stride, but more and more every year farmers are interesting themselves in dairying, and there is, I feel sure, a bright future for the application of the co-operative principle to it.

Co-operative Live Stock Markets.—Another form of State financial assistance which may not commend itself to you, but which I give for what it is worth, is in connection with co-operative stockyards. The producers of cattle for beef purposes complained bitterly for many years at the conditions prevailing in stockyards which did exist, and also of the very meagre stockyard provision which was made by the railway companies and those interested in the trade. The problem was a very real one, and finally an attempt was made to solve it by the formation of two co-operative organisations to control stockyards, one in the northern part of the province, and one in the south. Study of the subject showed very plainly that it was not possible, or at least was not likely, that co-operative stockyards could be profit-making institutions if they fulfilled the function of providing proper facilities with full liberty to farmers to use them. So it was decided in that case that if the farmers would themselves organise a co-operative stockyard, put their money into it on the same general principle as the others, that the State would in that case, not make a loan because of the little prospect of its repayment, but would make an outright grant of one-third of the cost of providing the facilities, because of the peculiar nature of the business. Here I would like to point out that one cannot adopt any general principle which applies to one commodity and, *ipso facto*, it will apply to all. It will not. Each commodity requires to be studied separately. The farmer is always the same in his beautiful diversity, you have always the same human materials to deal with. I have no hesitation in stating

that if we had made a loan to co-operative stockyards instead of a grant, no interest would ever have been paid on it, and the principal would never have been repaid, but the value of these co-operative stockyards to the stock industry cannot be over-estimated, because they provide a free market under the control of the producers themselves for the handling of their stock.

Advantages and Disadvantages of State Financial Help.—

I referred to the advantages and disadvantages of help being given by way of State management. Now I want to refer to the advantages and disadvantages as we see them of State financial help. There are no disadvantages so long as there is no trouble, but the moment trouble arises, as was the case with our co-operative creamery enterprise when it lost money, naturally, they all said, "What is the Government going to do about it?" There is the disadvantage of Government assistance—unless your Government possesses a stiffer neck collectively than most politicians do it is possible for very great political pressure to be brought to bear for the State to assume part of the financial burden brought about by something which the co-operative institution itself was wholly responsible for. I think the Co-operative Creameries shareholders in Saskatchewan will agree to-day that the refusal of the Government to hand out money to the institution, but just merely to stand by, was the best thing that could have happened to them at the time when they were facing such difficulties. I feel as certain to-day as I felt then that to have spoon-fed that institution during the crisis would have meant its death ultimately.

Co-operative Wheat Pool.—There is now in Western Canada a new development in co-operation about which you will hear probably a great deal in the near future, and in concluding my remarks, I want to give you some information about it. In spite of all the progress that has been made in co-operative work the farmers have not been fully satisfied with the application of the principle because it rested upon the same general idea as the consumers' co-operative organisation rests upon in this country; that is to say, in the control and sale of the product by the co-operative society and the return by the society to the individual of the market price of his product at the time of individual sale and also of dividends. They have not been satisfied very largely because of the fundamental conditions prevailing. I think you all agree that because of the position of

agriculture we are the last to feel the benefits, if benefits there be, of inflation and the first to feel the disasters of deflation. Consequently the price of everything we produce, and I think I can speak for the agriculturists of the whole world when I say this, has gone down practically to pre-war levels, and in some cases below, while the prices of everything of which we are consumers, including labour, remain considerably above pre-war prices. Labour is organised to-day to get a living wage; capital is organised to secure a return upon the capital invested. The farmer is the one man in all creation who when he buys says, "What is the price?" and when he sells asks exactly the same question. Other industries when they buy have something to say regarding the price, and certainly when they sell have a very great deal to say about it. Our farmers in Western Canada have become impressed with that, I might almost say obsessed with it, during the past few years, and they say briefly this: our present co-operative organisations do not change that situation, the only difference being that instead of the individual farmer going to market and saying: What is the price? the society goes to market and says, What is the price? So the farmer has been saying, somehow we must change that. The farmer must in some manner in the sale of his products have the advantage of mass selling which is enjoyed by every other industry, and he must attain that advantage co-operatively.

In Saskatchewan there are 100,000 sellers of wheat under our present system. Over in England here and in France I learn that the buyers of wheat for milling purposes are more and more getting together. I do not understand how it is possible for the world to imagine that the price of everything that is produced should go up, the price for a man's labour, for his capital, but side by side with that condition you can establish the principle that the price of food shall not go up. I cannot for the life of me understand it. There is a powerful regulator against unreasonable combination by farmers, and what is that regulator? The vacant spaces of the world which can be brought under cultivation provided the venture is profitable. There is a safer regulator in the farming industry than there is in any other industry in the world; political regulation is required for industry generally; for labour, laws are required; but the natural economic law rules the farmer; if his industry becomes more profitable more men come into it, and there is a lot of land in the world which can be put under crop. Of course we have the same tendencies as other people. We will get as much as we

can for what we produce, power is no safer in our hands than it is in the hands of any others when it is a power which is almost monopolistic. But fortunately there is a check upon it which does not exist in connection with any other industry that I know of. So there has been evolved the pooling co-operative method of marketing wheat. To English co-operators it will sound drastic, and you will wonder why men would submit themselves to the harshness of the provisions. I will tell you the reason. You cannot go on year after year losing money on your farm and getting deeper into debt, there is only one end to that—your mortgagee will put you off. So half the farmers of Saskatchewan, more than half the farmers of Alberta and nearly half the farmers of Manitoba have banded themselves together in what is called the Co-operative Wheat Producers, Ltd., for the purpose of marketing their wheat: they are not touching any other grain just at present, just wheat. They bind themselves in an iron-clad contract to turn over to the pool every bushel of wheat they produce for sale for the next five years. There is nothing in the contract regarding what the pool will pay them for it; that cannot be determined. The pool composed of themselves merely agrees in the contract to make an initial payment when the wheat is delivered, to sell all the wheat of all the farmers to the best advantage, and then to return to those producing it pro rata any balance remaining on hand over and above the initial-payment.

That briefly is the scheme. As to the merits of it only time can demonstrate. I am not disposed to criticise it, because it is a bona fide attempt to solve a very real problem through the medium of mass selling and averaging of the price returned. The relationship of the State to it is very slight indeed: one of the principles upon which it is based is that there shall be no politics about it.

In Alberta the wheat pool has been operating for one year. In Saskatchewan it comes into operation this year, and in Manitoba also; so that this year for the first time more than one-half of the wheat produced in the three provinces of Western Canada will be controlled so far as the selling of it is concerned by an organisation of the producers themselves.

Consumers here say: "Will it put the price of bread up?" Maybe it will, but nobody consulted the farmer when they put up the cost of everything that enters into the cost of wheat production. I do not know why it should be an axiom that the price of everything a farmer produces must be kept down while

the price of everything that everybody else produces must go up; I cannot understand why that should be an axiom in this old land and everywhere else. Everywhere I go they tell me, "Oh, but that will increase the price of food." Well, everybody who is eating that food which the farmer produces is getting more as the reward of his labour than he did get a few years ago, why should the farmer be the only man who is not to share in the general rise in the value of commodities. I do not know much of economics, but that strikes me as a most ridiculous proposition.

I spoke of the State relationship to the new pooling organisation in Saskatchewan. It passed over the province like a wave, the farmers joined it by the thousand, there are over 50,000 of them tied up by an iron-clad contract for five years agreeing that to the extent to which they break that contract by marketing any of their grain elsewhere, they will forfeit 25 cents a bushel by way of liquidated damages; that is pretty stringent, but they mean it. In order to secure the necessary 50 per cent. of acreage which the promoters of the pool believe to be necessary in order to guarantee the success of the scheme, it was found they would require funds to complete the organisation, and of course they came to the Government. I suppose that is one of the disadvantages of the head of the Government being a known co-operator. The Government considered the matter and decided that it would not be a sound principle to give this co-operative organisation any money, but we did decide also that when it was so near completion, the lack of a few thousand dollars could not in the general public interest be allowed to stand in the way of the completion of the experiment, so a loan was made, I think about 30,000 dollars, to assist in completing the organisation in order that the experiment might be carried out. The loan is a first charge upon the wheat handled by the pool when it starts to function; that is the only State assistance given by the province in connection with the new pooling method. I think it will work successfully, provided the farmers can throw up from among themselves the kind of brains that can handle it. It will be the biggest concern of its kind that has ever existed in the world, it will control more grain than ever has been controlled by a single organisation, and that organisation is altogether a producers' organisation, returning no interest on capital and financing purely on the commodity itself. There will be no difficulty at all about it getting credit, because the initial payment is of course always below the present market value of the grain. We are looking forward to a considerable development along co-operative pooling lines.

WIRE FENCING FOR GRASSLAND.

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FARMERS are putting down a good deal of land to grass, and in connection therewith are confronted with various problems, of which fencing the areas is one of the most pressing. There is no doubt that wire fencing is the cheapest and most effective way of controlling stock on pasture land.

Posts.—These are best made of wood; and of the various kinds of timber, larch is undoubtedly the cheapest and among the most durable. If larch thinnings can be obtained they make excellent posts and should be cut 5 ft. long and be of a minimum diameter at the small end of 3 in. Spanish chestnut poles are also thoroughly suitable and may often be purchased in 10 ft. or 15 ft. lengths at the price of 1d. or less per foot run, and they may be cut up into suitable posts. Posts should not cost more than 6d. each. The two kinds of timber indicated may be used in their natural condition and will have a life of about ten years, depending on the class of soil and the quality of the timber. Other wood that is suitable is ash, sycamore, birch, Scots fir, and spruce, but these woods in their natural condition have a very short life and should be creosoted before being used. A simple creosote tank would be one about 5 ft. long, 2 ft. wide, and 3 ft. deep, and if the posts after being pointed are placed with their lower ends in this tank and kept in creosote for a fortnight their life is greatly increased.

The posts should be placed at intervals of about 12 ft., if the ground is fairly level and if the fence runs straight, but on undulating ground and with a crooked fence the interspacing must be closer. The straining posts should be 7 ft. long and should go into the ground about $3\frac{1}{2}$ ft., with a diameter of about 6 in. at the small end. The success of the fence depends very largely on the way in which the straining posts are inserted, because if they are not thoroughly firm the wire soon becomes slack.

Any straining post can be fixed immovably in a hole 4 ft. deep, and, in fact, if it is difficult to get the post deeper than $3\frac{1}{2}$ ft. this depth will prove sufficient provided a little extra care is given to the details of fixing.

Every straining post should have an "anchor" fixed near its base. This consists of a piece of sound wood about 3 ft.

long and 3 in. or so in thickness, which may be round or squared: on the whole it is better squared. With the saw a notch about 2 in. deep is cut within 3 in. of the base of the post, the piece of wood taken out being of such a width that the anchor fits exactly into the slot, so that when it is driven home it is firmly held. To make all secure a long nail may be driven through the anchor to hold it immovably in position. It does not at all matter whether the anchor or cross piece projects equally on each side of the post or whether the whole of it projects from one side. The hole in the ground to receive the post should be about $3\frac{1}{2}$ ft. long and 12 in. to 15 in. wide, according to the size of the post, but there is no need to throw out more soil than is sufficient to allow the post to be easily inserted. If the end of the fence comes close up against another fence running at right angles, or against a wall or building, the trench for the insertion of the post should lie in the direction of the line of the fence, because only in this way can the terminal post be placed close to the pre-existing fence, building, or wall. If, on the other hand, the end of the fence is a gateway, the trench to receive the post had better be at right angles to the line of the fence; the anchor will then project equally on both sides of the post.

Having dug the hole and ascertained that it is approximately of the right depth, the post with its anchor attached is carefully dropped into the hole, with its centre exactly in the line of the fence. This having been done, a few spadefuls of soil are thrown in and carefully rammed round the foot of the post and along the side of the anchor. In order to get the soil into all the corners and angles of the hole the rammer should not be more than $2\frac{1}{2}$ in. in diameter, and if the post so fills the hole that there is not more than 1 in. or 2 in. of clear space between the sides of the post and the sides of the hole, the rammer for use in packing that part of the hole should not be more than 1 in. in thickness, a piece of wooden rail 3 in. \times 1 in. being useful for the purpose.

Having satisfied oneself that the position of the post is right, more soil is filled into the hole, one man shovelling while another confines himself to packing and ramming, sufficient time being given for the latter to do his work thoroughly. The secure fixing of the post is very largely a matter of thorough packing of the soil, and if a few stones 2 in. to 3 in. in diameter are available they should occasionally be thrown on the soil

close to the post and be beaten in. After the filling of the trench has proceeded to the depth of about 1 ft. or so, it is necessary to see once more that the post is perfectly perpendicular, because later it is impossible to rectify a mistake of this kind.

The trench having been filled and thoroughly rammed, the next thing to do is to fix the stay. If the post is a terminal one a single stay is, of course, all that is necessary. Even where the post is an angle one, that is to say, where the line of fence makes a right angle, more or less, at the post, some workmen, by way of economising, put in a single stay, so as to bisect the angle, but such a practice is not to be recommended, because the stay projects into the field and may possibly trip up stock. It is much better to insert two stays at an angle post, each of which will lie along the line of its respective fence. The stays must be sufficiently thick and strong to obviate any chance of bending when the pull of the fence is brought to bear upon them; but a stay 4 in. thick at the butt and 3 in. thick at the other end will suffice if it is of larch, oak, or Spanish chestnut.

A notch 1 to $1\frac{1}{2}$ in. deep is cut with a chisel rather to one side of the median line of the post, and about 2 in. below the point where the top wire will come. This having been done, and the end of the stay having been prepared so as to fit accurately into the notch, the other end is put on the ground at approximately the spot where it will ultimately be fixed. A bevelled hole about 15 in. deep is now made in the ground with a spade, and it is a good plan to make an allowance for a big stone or rough block of wood, say 15 in. long and 6 in. in section, to be placed transversely at the end of the stay, and about 6 in. below the surface of the ground. A little "humouring" will be necessary in order to get the supporting block or stone into its proper position, but the great thing is to see that the position is rather too near than too far from the straining post, because if it is too near it is easy to dig out a little more soil and let the block go back a trifle; and, finally, by using the stay as a battering ram it can be beaten tight against the undisturbed back of soil, and the other end of the stay can be accurately let into the notch in the straining post.

The intermediate posts are pointed and driven about 20 in. into the ground with an iron mell.

Wire.—For protection against horses and heavy cattle the wire must be stouter than for sheep and young horned stock. For the heaviest class of stock the top wire may be No. 4 gauge with five wires below of No. 6 gauge, which is quite sufficient. For lighter stock and sheep the top wire may be No. 6 gauge and the other wires of No. 8 gauge: for all practical purposes this makes an excellent fence. The interspacing of the wires should be about 10 in. between the top pair, then 8 in., 7 in. and 6 in. below. There is no doubt that solid galvanized wire is the best to use and costs at the present time about 18s. 6d. a cwt. Stretching of the wire may be done by any reliable machine, of which one of the best is the winch, called in Scotland a Monkey.

The distance between the strainers will depend upon the ground, but it is not usually necessary to have these less than 300 yds. apart, in fact one gets a tighter fence by wide interspacing than by having the terminals too close together.

The complete outfit of fencing tools would consist of a mell, costing about 15s.; a borer, 4 ft. long, of malleable iron, weighing about 14 lb., the price of which is about 5s.; a "Monkey," which will cost about 20s.; and 2 conical malleable iron pins, 12 in. long, to drive into the post to hold the wire tight after it has been stretched, costing about 1s. each. A holder for knotting the wire is also convenient, the price of which is about 2s. These, with a claw hammer, a chisel, a file, and an auger for boring the holes, complete the equipment. At present prices the total cost per yard should not exceed 1s.

While a wire fence is undoubtedly the cheapest and most effective form of fence, other kinds of fence, for instance, posts and rail may be used, but the cost of this is very much more than the wire fence. Sheep netting may be also employed for enclosing an area, but this is more expensive than wire and is much less effective.

* * * * *

APPLE AND PEAR SCAB.

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The Apple Scab Fungus (*Venturia inaequalis*).—In the Ministry's leaflet No. 131, on Apple and Pear Scab, the statement occurs: "As it is from diseased shoots that the scab starts afresh each year, it is worth making a determined

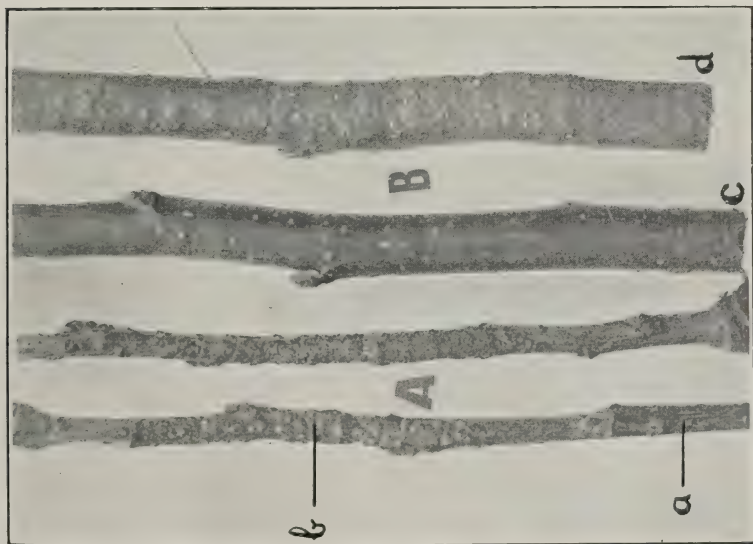


FIG. 1.—The Apple Scab or “Black Spot” fungus attacking the young wood of apples :—(A), on Cox’s Orange Pippin : (a), healthy wood ; (b), diseased wood, the blistered appearance being due to pustules of spores breaking through the bark. (B), on Wellington : (c), healthy twig ; (d), twig with diseased patch below.

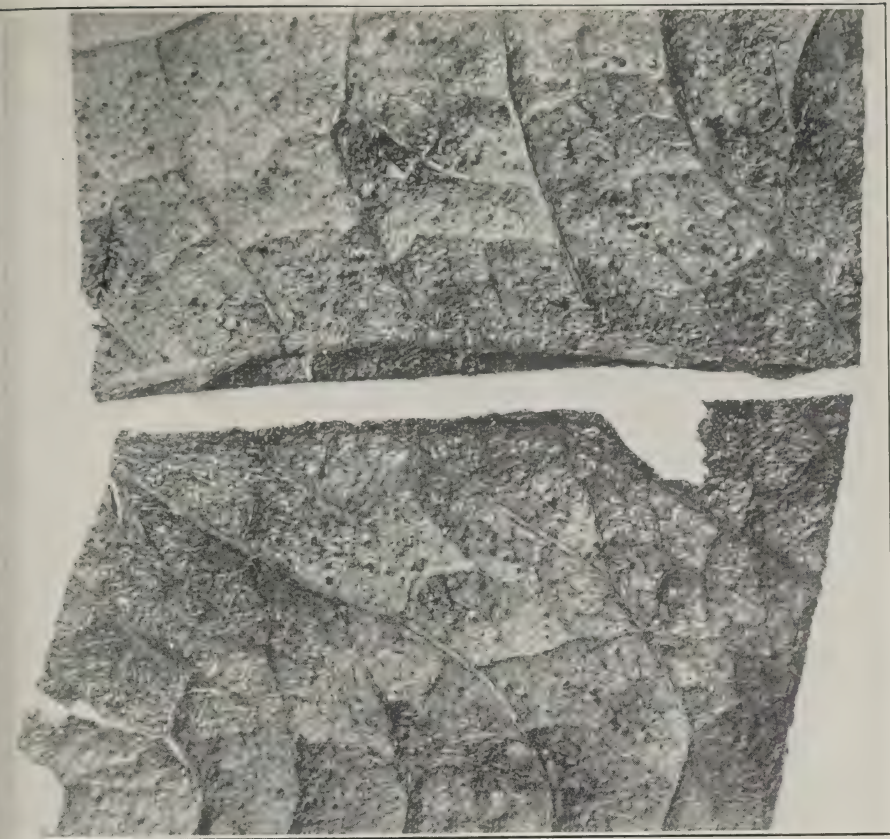


FIG. 2.—Fragments of Dead Apple Leaves (of the previous season) showing the pimply-like eruptions where the fruit-bodies of the Apple Scab Fungus are breaking through. Magnified 6 times.

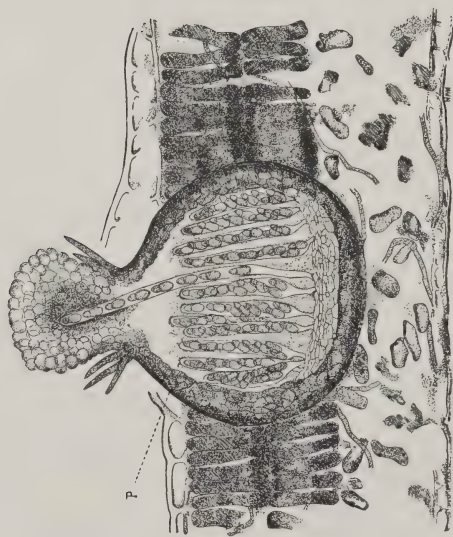


FIG. 3.

FIG. 3.—Section of Dead Apple Leaf, showing a fruit-body (P) of the Apple Scab Fungus, with its winter spores. Magnified 200 times.

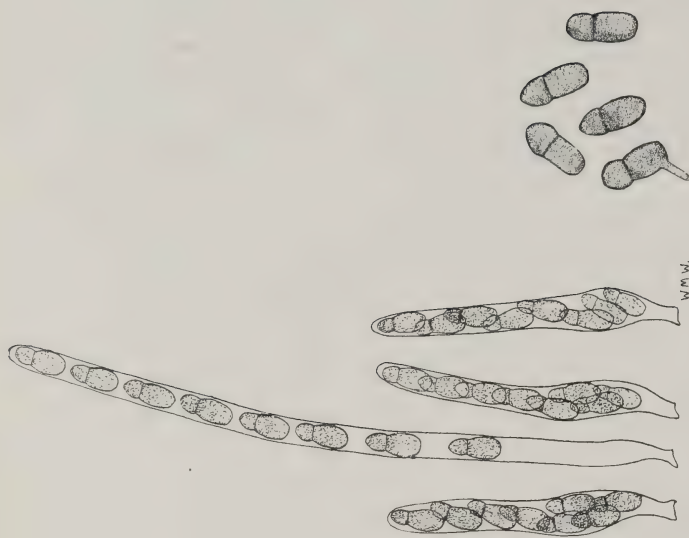


FIG. 4.

FIG. 4.—Apple Scab Fungus; *asci* and *ascospores*. The long cylindrical *ascus* is about to discharge its *ascospores*. Magnified 500 times.



FIG. 5.

FIG. 5.—Apple Scab Fungus; *ascospores*. Magnified 666 times.

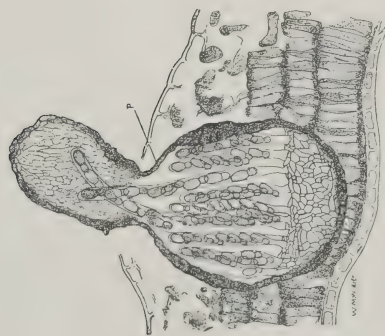


FIG. 6.

FIG. 6.—Section of dead Pear Leaf, showing fruit-body (P) of the Pear Scab Fungus, with its winter spores. Magnified 200 times.

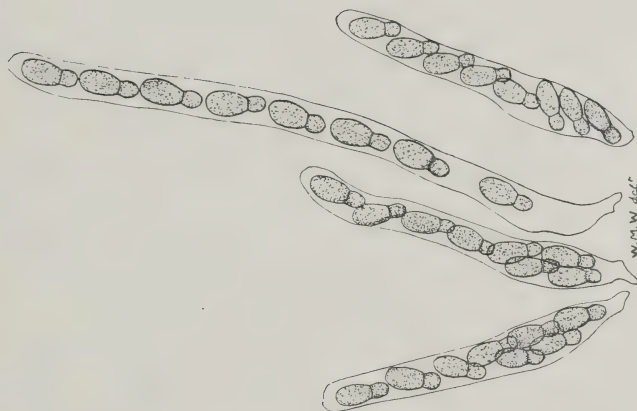


FIG. 7.

FIG. 7.—Pear Scab Fungus; *asci* and *ascospores*. Magnified 500 times.



FIG. 8.

FIG. 8.—Pear Scab Fungus; *ascospores*. Magnified 625 times.

effort to attack the fungus in this position and also to prevent it from infecting the wood in future seasons." This statement accurately represented up to the present year our knowledge as to the manner in which, in this country, the fungus causing apple scab or black spot lives on through the winter to the succeeding summer. While it remains true that the scabbed young wood of certain varieties of apples,* which is shown in Fig. 1, is undoubtedly a prolific source of infection, we have now to record the existence in England of the true winter-stage of the apple scab fungus—a stage well known in most, if not all, of the apple-growing countries of the world, but hitherto unreported for this country.

In February last, on visiting an orchard near Maidstone planted with Bramley's Seedling and Newton Wonder trees, we observed numbers of the previous season's leaves lying on the grass. That season (1923) the trees had been severely infested with scab, both on the leaves and fruit, and most of the leaves found in February showed evident spots where the scab had been present during the previous season. These leaves were brought into the laboratory and kept damp. After a week or so fruit bodies of a fungus were seen to be developing, and on the thirtieth day after being brought into the laboratory these were ripe and ejecting their winter-spores.

The general appearance of the fungus at this stage is as follows: the apple leaves show, scattered over their whole surface (irrespective of the distribution of the scab spots formed in the previous season), minute dark brown or black pimple-like bodies (*perithecia*) which have broken through the skin of the leaf, often on both surfaces. These bodies are just visible to the naked eye and are best seen when the leaf is damp. A photograph of two fragments of a leaf (magnified six times) bearing numbers of these bodies, is reproduced in Fig. 2. With a pocket lens the minute projecting necks can often be distinguished. If a section of a dead apple leaf is cut and examined in water under the microscope, the structure of these spore-containing fruit-bodies can be observed (see Fig. 3). The fruit-body (*perithecium*) is flask-shaped, with a projecting neck, and is filled with a large number of little sacs (*asci*), each of which contains eight two-celled winter-spores (*ascospores*) (Figs. 4 and 5). As soon as the perithecium is mature and

* Leaflet 131 may be profitably consulted by the fruit-grower on the subject of apple scab and its control. Full information is given on such important practical points as the most susceptible varieties, as regards fruit and young wood, as well as the best fungicides to use to control the disease.

obtains sufficient moisture, the winter-spores are ejected from the little sacs and forcibly expelled through the mouth of the perithecium into the air. The late Dr. R. Aderhold, a German mycologist, whose investigations* have thrown so much light on the life-histories of the apple and pear scab fungi, found that the apple scab fungus throws out its winter-spores into the air to a distance of $1\frac{1}{2}$ cm. ($\frac{3}{5}$ in.).

A search was then made in apple plantations in other parts of Kent, and dead apple leaves bearing ripe perithecia were found in abundance at Wye, and at Egerton, near Ashford. The fungus above described was recognised as that called *Venturia inaequalis* on the Continent and in America. Many workers abroad have carried out experiments which have proved it to be the winter-stage of the apple scab fungus, which in its summer stage (*Fusicladium dendriticum*) is the cause of the "scab" or "black spot" of the apple and the sooty blotches on apple leaves. This winter-stage on dead apple leaves has not hitherto been found in English fruit plantations, nor been proved in this country to be connected with the apple scab disease.† The experiments described below establish definitely the connection between the two.

In the first experiment, winter-spores were caught in drops of water placed on slips of glass suspended over dead apple leaves bearing mature fruit-bodies (*perithecia*). The winter-spores germinated at once, and by the second day bore long germ-tubes.

In one instance sporelings, after being occasionally deprived of moisture and then wetted again—a process which, as Dr. Aderhold has noted, is favourable to the initial stages of development of this fungus—were provided with a few drops of apple-leaf extract. Growth continued, organs of anchorage (*appressoria*) were developed and by the sixteenth day after germination there were produced the well-known summer-spores (*conidia*) of the apple scab fungus.

In the other experiments, living apple leaves were inoculated with winter-spores obtained from dead apple leaves. In one

*R. Aderhold; Die Fusicladien unserer Obstbäume (*Landwirtsch. Jahrb.*, XXV, 875 (1896).)

† In articles in the "Gardeners' Chronicle" (April and May, 1924) we have pointed out that as long ago as 1866 Cooke (in *Journ. of Bot.*, IV, p. 248) described this fungus on dead apple-leaves as "*Sphaerella inaequalis*," and we have seen, in the Kew Herbarium, a specimen collected by him at Henlow, Beds., April, 1866. It was not known at that time that the fungus in question was connected with the apple scab fungus (*Fusicladium dendriticum*) and this old record of what has since been recognised as the winter-stage of the fungus has remained completely forgotten for 58 years.

case pot plants of French Paradise were used, kindly supplied to us by Mr. R. G. Hatton. Twenty-two leaves were inoculated, on 28th April, in the following manner:—

Ripe fruit-bodies of the fungus were picked out with a needle from a dead apple leaf and allowed to discharge winter-spores into distilled water in a watch glass. Subsequently a little of this water (which contained many thousands of the spores which had been discharged) was drawn up in a fine glass tube and blown out again, with the spores, on to the upper surface of the apple leaf. All the leaves, including those inoculated, were kept moist from day to day by atomising them with water. Some of the inoculated leaves were kept for 15 days in glass chimneys with plugs of cotton wool at the outlet (for 10 days), while others were freely exposed to the air. On 6th May (8 days after inoculation) many of the leaves showed pale, translucent spots, and on 13th May (15 days after inoculation) characteristic dark spots of scab appeared, which on microscopic examination were found to be bearing an abundance of the summer-spores—the so-called *Fusicladium* stage. All the control leaves remained quite free from scab.

The total number of apple leaves inoculated in our experiments was 22 and the number which became infected was 13, i.e., 59 per cent. In Dr. Aderhold's experiments the percentage of successful infections was about 33. A similar successful experiment was carried out on the leaves of a commercial variety of apple in the open.

We have observed at Wye the ejection of winter-spores from dead apple leaves under the following conditions. On 27th April some freshly collected dead apple leaves, bearing the fruit-bodies, were kept damp on wet blotting paper in glass dishes. A small slip of glass, previously moistened on the lower surface, was suspended a short distance above each leaf. Within a short time, winter-spores had been shot up by the fungus into the minute drops on the moistened surface. In one experiment leaves placed in the open at 4.30 p.m. were found, by 9.10 p.m., to have ejected hundreds of spores, the temperature varying between 45° and 46° F. during the period. Just previous to the ejection of the spores, the sac undergoes a rapid and practically instantaneous elongation, to approximately twice its original length. The spores are then discharged in quick succession, like bullets from a machine-gun, and the sac then contracts. It is clear, therefore, that during cold, wet periods in April and May,* such as were experienced last spring, the

* We observed ripe ascospores as early as 7th March.

apple scab fungus on dead apple leaves on the ground is discharging spores into the air; these spores, carried to the young apple leaves, infect them and give rise to the well-known dark, sooty patches of scab. On the living apple leaves the fungus increases rapidly, producing multitudes of summer-spores. These, carried by wind and rain, infest the fruit, and produce the "black spot" or "scab," a disease unfortunately so characteristic of much of the apple crop grown in this country.

Economic Importance of the Occurrence of the Winter Stage of the Apple Scab Fungus.—It is probable that the occurrence of a winter stage in the life history of the fungus in this country has a very direct bearing on the *early outbreaks* of apple scab in our orchards and plantations. It is no uncommon occurrence for severe infestations of scab to take place season after season on varieties of apples which show none, or but little, of the disease on their young wood. One case which has lately come to our notice may be instanced here.

In connection with some spraying experiments we inspected rows of the Bismarck variety in a plantation at Egerton, near Ashford, in the spring of 1923, at the time when the trees were just out of flower. At this early date the trees were already somewhat severely infested with scab, patches of which occurred on many of the oldest leaves surrounding the flower-trusses. A close inspection was made of the young wood, which was found to be free from scab with the exception of one or two pustules on a very few trees. This early outbreak on the Bismarcks remained inexplicable, since at that time the occurrence in this country of the winter stage of the apple scab fungus had not been observed; it was conjectured at the time that some rows of Cox's Orange Pippin, which stood some 50 yards away, and whose wood was badly scabbed, had been instrumental in causing the outbreak.

This season (1924) a similar early and severe outbreak on the Bismarcks was noticed; on 1st May, before the trees were in flower, a leaf here and there round the flower-trusses could be found with a spot of scab, usually on the under-surface of the leaf. By 21st May, when still in flower, these three rows of Bismarck (22-30 trees in the row) showed, on nearly every tree, a number of the leaves round the flower-trusses, with well-established spots of scab, bearing abundant summer-spores. As in this plantation (notwithstanding the fact that pigs had been turned in) it was not difficult during

April and May to find on the ground remains of the previous season's dead apple leaves bearing ripe fruit-bodies discharging winter-spores, there seems little doubt now that the early outbreak of scab in this case—as in many others—is to be attributed to infection arising from the ground.

Control of Apple Scab.—It is clear from the observations recorded above that a prolific source of infection may exist in the spring in the dead scabbed leaves of the previous season. To some extent close grazing by sheep in the orchard, and careful folding of the plantation with pigs will tend to the destruction of the dead apple leaves, although, where these have been plentiful, it is to be feared that enough material* will be left to start early outbreaks of scab. In gardens, and possibly also where choice varieties of apples are grown on an intensive system, as on cordons, it may be found practicable to sweep up and burn the leaves from diseased trees in the autumn. Whether the formation of the winter stage of the fungus takes place every winter in this country, or only in those winters (such as the last) characterised by dry cold weather, can be determined only by future observations. It is possible that in wet, mild winters the apple leaves decay before the fungus can produce its fruit-bodies.

There can be little doubt, however, that for the commercial fruit grower the best practice is to prevent the formation of the winter stage of the scab fungus, rather than attempt to destroy it when it has occurred. Two or three careful sprayings in spring and early summer will prevent the leaves on the tree from becoming infested with scab, and thereby remove any possibility of their becoming a source of infection in the following spring. The same operation will also prevent the production of scabbed young wood, the other possible source of infection in the spring.

On some varieties of apples—*e.g.*, Cox's Orange Pippin, Worcester, Bismarck—the first spraying of the leaves (where the trees have borne a scabbed crop in the previous season) must be given *just before* the trees flower, *i.e.*, when the flower-buds are showing pink but have not yet opened. This spraying will prevent early attacks of scab on the first produced leaves round the flower-trusses. Another important time for spraying is when the petals have just fallen. This is undoubtedly the most important of all the sprayings, and must

* Wallace, an American mycologist, has computed (Cornell Univ. Agric. Exper. Station, Bull. 335 (1913)) that from a fragment of leaf 1 cm. square, 5,630 winter-spores may be discharged in 45 minutes.

never be omitted on trees liable to scab. At this date the majority of the young leaves will be protected by the fungicide used. In many cases another spraying, three weeks or a month later, will be found profitable.

The best spray fluids* for the purpose are Bordeaux mixture (using the excess lime Bordeaux where scorching of the leaves or russetting of the fruit is likely), or lime-sulphur (on those varieties liable to injury by Bordeaux mixture). A third spray fluid, viz., lime-sulphur mixed with arsenate of lead (1 gal. lime-sulphur to 29 gal. water, and 4 lb. arsenate of lead paste to the 100 gal. of spray fluid) gave very good results in some experiments carried out in 1923. These experiments are being repeated this year, and the detailed results obtained in the two seasons will be published later.

The Pear Scab Fungus (*Venturia pirina*).†—After the discovery (noted above) of the winter-stage of the apple scab fungus on dead apple leaves, a search was made for the similar stage of the pear scab fungus on dead pear leaves. This was found during March, 1924, at Wye, Kent, on dead pear leaves collected by the wind at the foot of a hawthorn hedge, close to pear trees which had borne scabbed fruit for a number of seasons.

The fruit-bodies (*perithecia*) of the fungus are just visible to the naked eye as minute dark coloured points scattered, or thinly grouped, over either or both of the surfaces of the leaf. Within the fruit-body (see Fig. 6) are large numbers of little sacs (*asci*), each containing eight two-celled winter-spores (*ascospores*) (see Figs. 7 and 8). When the fruit-bodies are ripe, the winter-spores are forcibly discharged in quick succession from the mouth of the neck. On 28th April, freshly collected dead pear leaves bearing the fungus were, after being wetted, placed out of doors and it was found that the fruit-bodies continued to eject hundreds of winter-spores during the day. The weather at that time was dull, with occasional sunshine and a cold wind; the temperature varied from 49° F. to 55° F.

It seems possible that the development of winter-spores of the pear scab fungus on dead pear leaves takes places commonly in this country, but has been generally overlooked. Dead pear leaves obtained last March from near Barnstaple,

* The formulæ for these will be found in the Leaflet No. 131, on Apple and Pear Scab, issued by the Ministry.

† A technical description of the fungus has already been given in the "Gardener's Chronicle," 10th May, 1924.

North Devon, were producing this stage in abundance. On the Continent of Europe, and also in the United States, the winter stage of pear scab is of common occurrence; in Germany (Silesia), according to the statement of the late Professor Aderhold, it is the exception to find dead pear leaves free from this stage of the pear scab fungus.

It can be considered as certain that wherever the fungus has developed its fruit-bodies in the dead pear leaves the winter-spores are discharged from these in vast numbers all through the spring months, from April on into June. These winter-spores, carried by currents of air to the young pear leaves or fruit, infect them at once and produce the well-known velvety spots of scab.

Hitherto in this country that stage of the pear scab fungus which occurs on the young wood (one- and two-year-old shoots) of the pear tree has been the only one known which carries the disease over from one season to the next. Now that a further stage in the life history of the fungus has been found in this country, we can lay down certain rules as regards the best methods of controlling pear scab.

In gardens, as well as in certain special cases in the commercial plantation, it may be advisable to collect and burn the scabbed leaves when they have fallen in the autumn or to dig them well into the ground. If the dead leaves are converted into leaf-mould, this should not be used on ground near pear trees until it is old and well rotted. For pear growers on a commercial scale, however, the main safeguard against attacks of pear scab lies in spraying the leaves while healthy, and so preventing them from becoming scabbed and from becoming later, when fallen to the ground, the home of the winter-spores of the fungus.

Directly the blossom is set (or, better, while a few flowers still remain open) spray the tree thoroughly with Bordeaux mixture, using a fine, misty spray and taking care to wet the under surfaces of the leaves. Repeat the spraying with Bordeaux mixture three weeks later. These early sprayings are essential for the control of pear scab; they prevent the fungus from infecting the leaves and producing there immense numbers of spores, which in showery weather, passing to the young pears, make them scabby and often cause them to crack. Bordeaux mixture is, in our experience, the best fungicide to use against pear scab; it is quite harmless to the foliage of any variety of pear, whereas lime-sulphur is not so strong a

fungicide and when used on some varieties, *e.g.*, William's Bon Chrétien, may injure the foliage. Two good sprayings of Bordeaux mixture applied early, usually suffice to keep down the scab disease on pears; where the trees have been neglected for several seasons, however, a third spraying with Bordeaux mixture three weeks after the second, should be given. As a rule, winter spraying against pear scab is useless; where, however, an appreciable amount of scabbed wood exists in the tree, a spraying in March with lime-sulphur at winter strength (1 gal. of the concentrate (1.30 sp. gr.) to 14 gal. water) will do good. As much as possible of the scabbed wood should be cut out in pruning. The fact should not be lost sight of that the summer spraying of the leaves with Bordeaux mixture, as described above, will protect the young wood, as it develops, from scab infection.

The two known sources of infection in the spring would then be eliminated, *viz.*, the scabbed wood with its spores and the dead scabbed pear leaves with their winter-spores.

One other point of practical importance deserves to be noted. Investigations have shown that the spores of the pear scab fungus require a drop of moisture (rain or dew) in order to be able to germinate, and, in accordance with this fact, many observers have noticed that espalier-grown pears protected from direct rain suffer less from scab. In special cases, as in the growing of valuable dessert pears, it might be practicable to provide protection from the rain; or to adopt another method, recommended in France for use in the growing of the choicest pears ("les fruits de luxe"), *viz.*, to tie on paper bags over the young healthy pears to preserve them from becoming infected later in their growth.

Summary.—Recent observations have shown that in this country also, as in the other fruit-growing countries, the apple and pear scab fungi develop a winter stage in the dead "scabbed" leaves after these have fallen to the ground, and that the winter-spores there produced are expelled in the spring and infect the young leaves and fruit, producing the well-known "scab" disease.

The discovery of this stage makes the spraying of apple and pear trees all the more necessary, in order to protect not only the fruit of the current season but also to prevent the fungus from growing on the leaves, and when these have fallen to the ground developing winter-spores which will restart the disease early the next season.

LIVESTOCK IMPROVEMENT IN ENGLAND AND WALES IN 1923-4.

THE reasons for the introduction of the Livestock Improvement Scheme in 1914, its object and the lines on which it operates have been set out so fully and often in the *Journal* and elsewhere as to need but brief recapitulation here.

At the outset it was realised that the funds available for the purposes of the scheme in England and Wales precluded any ambitious attempt at the direct provision by the Government of high-class sires required for use in the grading up of inferior farm stock, even had this been practicable or advisable.

The scheme was, therefore, framed more as an educational measure with the object of showing, by practical demonstration throughout the country, the importance and value of care in the selection and use of good pedigree sires and the direct gain resulting from the application of knowledge obtained from taking milk records and managing dairy herds in a more systematic and economic manner.

For these purposes annual grants are made to bull, boar and heavy horse societies which undertake the provision of approved pure-bred sires for the use of their members and to milk recording societies operating under the scheme.

That the objects aimed at are being achieved is indicated by the annual increase in the number of sires subsidised and the growing interest in and development of the milk recording movement as shown in the tables herewith.

Apart from the direct benefit accruing to the agriculture of the country by reason of the grading up of inferior stock through the instrumentality of the scheme—the focussing of attention on livestock improvement and the association of the Ministry's Livestock Officers with farmers and small holders in their several districts has had some influence, though indirect, in stimulating interest in breeding, in increasing the number of breeders and users of pure-bred cattle and pigs, and in creating a bigger demand for suitable sires amongst people not directly concerned with the scheme.

Bulls.—The total number of bulls actually located for service during the year ended 31st March, 1924 (*i.e.*, continued from previous years with renewed grants or provided for fresh districts during the year), was 978, an increase of 31 on the preceding year.

BULL SCHEME.

(Showing the number of Bulls subsidised during the past 10 years.)

<i>Year.</i> <i>1st April to</i> <i>31st March.</i>			<i>Societies.</i>			<i>Individuals.</i>	<i>Total No.</i> <i>of Bulls.</i>
1914-15*	...	...	369	...	...	43	497
1915-16	...	...	489	...	...	28	633
1916-17	...	...	543	...	...	15	659
1917-18	...	...	578	...	...	14	710
1918-19	...	...	604	...	...	7	721
1919-20	...	...	568	...	...	6	675
1920-21	...	...	561	...	...	6	668
1921-22	...	...	726	...	...	3	847
1922-23	...	...	831	...	...	1	947
1923-24	...	...	840	...	...	1	978

* Including the period 1st February, 1914—31st March, 1914.

This increase, though not large, is satisfactory in view of the restrictions on movement of stock in force during a large portion of the year owing to the prevalence of foot-and-mouth disease. In districts not so hampered the Ministry's Livestock Officers report very favourably on the progress of the scheme and the marked improvement in the young stock where premium bulls have been in use for some time. It is satisfactory to note the general and continued success of premium sires and their progeny at sales and shows. One of the Ministry's Livestock Officers reports that stock by premium bulls have been successfully shown at every show in his district, and at one of these shows every first prize was won by animals which were sired by premium bulls. In another instance twelve animals under two years old sired by a premium bull secured the highest average at the market on that day, and as a result of this success four new members joined the society in order to have the benefit of using this sire. Another of the Ministry's Livestock Officers recently attended a meeting of small holders for the purpose of explaining the advantages of the scheme, and at the close of the meeting eight of the number present guaranteed to advance £10 apiece to start a society and buy a pedigree bull. This decision was partly attributable to the fact that two farmers present at the meeting had seen for themselves the improvement resulting from the work of another society in the district, and emphasises the value to agriculturists of practice over precept.

In some dairying districts, even where calves are reared in considerable numbers, there is still much leeway to be made

up. The high prices still commanded (and likely to be) for suitable bulls of dairy strain may partly account for this, and continued effort is necessary to convince such breeders that it is poor economy to continue using nondescript sires about whose breeding little or nothing is known.

There was again a drop in the prices of bulls, other than those of dairy type, purchased during the year under review, and the average price of all the bulls provided was consequently lowered. The following table shows the number of bulls of each breed subsidised and the average cost for the first year and last two years of the scheme:—

NUMBERS AND PRICES OF BULLS OF EACH BREED.

Breed	1914-15			1922-23			1923-24		
	No.	Average Cost		No.	Average Cost		No.	Average Cost	
		£	s.	d.		£	s.	d.	
British Friesian ...	—	—	—	6	77	15	8	5	74 16 0
Devon ...	16	40	17	6	90	59	10	3	106 57 16 0
Guernsey ...	—	—	—	7	53	9	3	12	51 10 0
Hereford ...	63	33	7	6	84	58	3	4	100 50 19 0
Lincoln Red ...	33	31	10	0	94	63	14	11	101 55 11 0
Red Poll ...	—	—	—	1	78	15	0	—	—
Shorthorn ...	337	37	17	0	553	64	16	3	573 57 10 0
South Devon ...	6	36	11	6	17	58	11	6	15 47 5 0
Welsh Black ...	35	29	9	0	64	52	2	11	62 52 1 0
Other Breeds ...	7	29	4	6	—	—	—	—	—
All Breeds ...	497	36	0	0	916	62	11	9	974* 56 3 0

* 978 bulls were located, but grants in respect of 4 were in suspense at the end of the year.

As was the case in the preceding year the service fees varied from 2s. 6d. to 10s. 6d. It will be seen from the sub-joined table that there was again a substantial increase in the number of bulls serving at 5s., but the number serving at a higher fee remained about the same (*i.e.*, 277 compared with 271 in the previous year). The average service fee for all the bulls was 5s. 3d.

SERVICE FEES.

Year	2/6	3/-	3/6	4/-	4/6	5/-	5/6	6/-	6/6	7/-	7/6	8/-	8/6	9/-	10/-	Over
1914-15	265	57	41	42	3	88	—	—	—	—	1	—	—	—	—	—
1922-23	50	40	28	84	10	430	3	53	2	10	141	7	8	2	45	6
1923-24	51	46	25	71	9	491	2	84	2	12	126	6	7	1	26	5

Boars.—There was a satisfactory increase in the number of boars available during the year ended 31st March, 1924 (*i.e.*, continued from previous years with renewed grants or located in fresh districts during the year), the number being 638 as compared with 569 in the preceding year. The difficulty of forming Boar Societies is apparent in the fact that of the 638 boars available 550 were provided by individual owners.

BOAR SCHEME.

(Showing the number of Boars subsidised during the past 10 years.)

<i>Year. 1st April to 31st March.</i>	<i>Societies.</i>		<i>Individuals.</i>		<i>Total No. of Boars.</i>	
1914-15*	...	115	...	—	...	115
1915-16	...	180	...	—	...	193
1916-17	...	186	...	15	...	216
1917-18	...	172	...	92	...	264
1918-19	...	156	...	167	...	350
1919-20	...	120	...	225	...	399
1920-21	...	135	...	285	...	441
1921-22	...	113	...	416	...	550
1922-23	...	93	...	451	...	569
1923-24	...	78	...	541	...	638

* Including the period 1st February, 1914—31st March, 1914.

In several districts more applications for premium boars were received than could be met from the number of grants available. In other districts a strong preference for a local type of pig not recognised as a distinct and established breed has prevented the fullest use being made of the scheme. In some such districts efforts are being made to register and form herd books, and to secure recognition from the Ministry for the purpose of the Boar Scheme. In this connection it may be noted that the Ministry has recently, after consultation with its Advisory Livestock Committee, extended this recognition to the Welsh pig.

As in the case of bulls, premium boars and their progeny have attained general success at sales and shows, the natural result of the improvement which has taken place in districts which have been served by premium boars for some years.

Increasing interest has recently been shown in the production of the most suitable type of pig for bacon factories, and efforts are being made to meet the requirements of local factories in this respect by encouraging the most suitable type of sires.

It will be seen from the following table that the average price of the boars located under the scheme during the year

under review was £14 6s. 2d., which was slightly lower than the previous year's average, viz., £15 0s. 4d. The most popular breeds at present are the Large White, Large Black and Middle White.

NUMBERS AND AVERAGE PRICES OF BOARS OF EACH BREED.

Breed	1914-15		1922-23		1923-24	
	No.	Average Price	No.	Average Price	No.	Average Price
		£ s. d.		£ s. d.		£ s. d.
Berks	10	8 0 0	11	18 2 3	10	17 1 9
Cumberland ...	—	—	30	16 5 0	29	14 5 3
Essex	—	—	4	23 7 6	5	19 9 9
Glos. Old Spot ...	7	7 1 0	37	21 8 0	32	15 8 3
Large Black ...	18	7 5 6	141	14 12 7	138	13 4 4
Large White ...	64	7 3 0	199	13 13 10	250	14 11 9
Lincoln Curly Coat	4	8 4 6	31	12 3 10	35	11 16 10
Middle White ...	12	6 17 0	77	15 11 7	98	14 16 9
Large White Ulster	—	—	2	16 0 0	6	16 6 8
Tamworth ...	—	—	1	20 0 0	2	18 18 6
Wessex Saddleback	—	—	13	16 2 3	14	14 12 6
All Breeds ..	115	7 5 3	546	15 0 4	619*	14 6 2

* 638 Boars were located, but grants in respect of 19 were in suspense at the end of the year.

The service fees varied from 2s. 6d. to 10s. Considerably more than one-half the boars served at a fee of 5s., while a third of the remainder served at 7s. 6d. The average fee for all the boars was 5s. 5d., a trifle lower than in the previous year.

SERVICE FEES.

Year	2/-	2/6	3/-	3/6	4/-	4/6	5/-	5/6	6/-	6/6	7/-	7/6	8/-	8/6	10/-	Over 10/-
1914-15	21	62	10	5	6	—	2	—	—	—	—	—	—	—	—	—
1922-23	—	7	12	13	37	5	300	—	51	4	2	99	—	4	13	1
1923-24	—	9	9	12	44	1	368	1	58	2	4	104	—	2	5	—

Milk Recording.—No part of the Livestock Scheme has made more satisfactory progress than milk recording. Notwithstanding the many serious obstacles arising out of the abnormal conditions prevailing during the first five or six years of the operations of the scheme, the movement has continued to spread until at the present time practically every county in England and Wales has its own recording society or societies, and no district is outside the radius of one or other of these societies. During the year under review 416 new

members, owning 10,000 cows, have been enrolled, and in view of the hampering restrictions consequent on the serious outbreaks of foot-and-mouth disease over a large part of England and Wales this increase may be considered satisfactory. The following table shows the growth of the movement since its commencement.

	<i>Year.*</i>	<i>Societies.</i>	<i>Members.</i>	<i>Herds.</i>	<i>Cows.</i>
1st April to 31st March.	1914-15	16	264	306	7,331
	1915-16	20	350	398	9,811
	1916-17	22	441	495	12,950
	1917-18	25	503	555	14,404
1st October to 30th September.	1917-18	27	639	708	19,793
	1918-19	38	1,191	1,332	37,880
	1919-20	46	2,075	2,312	61,323
	1920-21	52	3,328	3,664	97,903
	1921-22	55	3,949	4,362	117,023
	1922-23	55	4,365	4,767	127,151

* Prior to 1st October, 1917, there was no uniform year for societies.

Average Yield of Herds Recorded.—The annual returns furnished by the 55 societies for the recording year ended 1st October, 1923, show that of the 127,151 cows and heifers recorded, 54 per cent. were cows which had been retained in the herds for the full year, and that the average yield of these 68,349 cows was approximately 7,000 lb., an appreciable increase over the averages of previous years.

Many societies averaged considerably more; for instance, the Hampshire Society with 3,251 full-year cows averaged 7,601 lb.; and the Essex Society, which for the year ended October, 1918, had only 407 full-year cows yielding on an average 6,531 lb., has shown remarkable development, having had in the last milk-recording year 4,388 full-year cows whose average yield was 7,499 lb., a tenfold increase in membership and of approximately 1,000 lb. in the average yield of the cows.

When the milk-recording movement was initiated by the Ministry the thousand-gallon cow was talked about and sometimes got into print, and though the object of the scheme is not to encourage the production of phenomenal milk yielders, it may be of interest to record that last year 125 herds—not cows—averaged 10,000 lb. per cow or over: good evidence of the value of milk recording and of the results obtained by careful weeding out, selection and breeding.

The following statement compares the average annual yield of (1) all cows and heifers recorded, and (2) of the cows

recorded for the full year for each year since the uniform milk-recording year was fixed:—

Year: 1st Oct. to 1st Oct.	No. of Societies	Particulars of all Cows and Heifers recorded			Particulars of Cows recorded for full year			
		No. of Cows and Heifers	Total Yield	Average Yield	No. of Cows	Percentage of Total Cows	Total Yield	Average Yield
1917-18	27	19,793	gal. 8,426,958	gal. 426	8,775	44	gal. 5,255,923	gal. 599
1918-19	38	37,880	16,204,941	450	17,989	47	10,543,516	579
1919-20	46	61,323	29,344,887	479	27,266	44	17,363,347	637
1920-21	52	97,903	48,512,380	495	48,248	49	30,892,620	640
1921-22	55	117,023	60,463,617	517	63,318	54	41,208,073	651
1922-23	55	127,151	67,904,224	534	68,349	54	46,956,565	687

While the total average yield continued to improve steadily, a much more marked advance is shown in individual herds as a direct result of the more systematic and economic management following the adoption of milk recording. As an instance of this, in the returns for 33 of the herds (of over 20 cows) of one society which have been recorded from 1917-18 to 1922-23, there was an average increase in the yield per cow of full-year cows of 92 gallons. The maximum increase shown by a herd was 234 gallons per cow.

Milk Record Certificates.—The number of milk record certificates issued to members was 2,065. This number represents 1.62 per cent. of the total number of cows recorded. Of the 2,065 certificates issued, only 155 were for yields of less than 6,000 lb., 1,367 were for yields between 6,000—10,000 lb., and 543 were for yields of over 10,000 lb.

Register of Dairy Cattle.—The seventh volume of the Ministry's Annual Register of Dairy Cattle,* covering the year under review, has been issued. It contains particulars of 1,321 cows (belonging to 271 members) in respect of which certificates have been issued by the Ministry showing that they have certified yields of 8,000 lb. or over of milk during the milk-recording year ended 1st October, 1923, or an average of 6,500 lb. for that year and one or more preceding consecutive years. Twelve recognised breeds or types are represented in the seventh volume, and there are, in addition, 57 crossbred cows (*i.e.*, cows which do not conform to one recognised breed or type), whose milk yields have justified their inclusion under the standard required. Of the 1,321 cows entered in the

* Price 2s. 6d., post free, from the Ministry.

seventh volume, 1,165 gave over 8,000 lb. of milk during the year, and 156 were entered on an average of 6,500 lb. or over. Of the 1,165 cows which were entered on the one year's yield 482 gave over 10,000 lb.

The seventh volume of the register contains the second list of cows in respect of which certificates of merit have been issued certifying that such cows have yielded not less than 24,000 lb. of milk over a period of three consecutive years and have calved at least three times during that period. This section, and the sections for dairy bulls, have been better supported than was the case in the previous volume, and it is hoped that in course of a few years the information given in these sections will constitute a valuable part of the register. Steps are being taken by the Ministry to popularise the register and to increase its scope and usefulness to all classes of dairy farmers.

After consultation with its Advisory Live Stock Committee the Ministry has made certain important changes in the conditions of entry into the Register, the principal of which are:—(1) the issue of a Certificate of Milk Record will not be required as a condition of entry; (2) entry will be made on the basis of one year's yield only.

The alterations have been made with the object of securing a more comprehensive and valuable book of reference for the use of members of milk recording societies and others interested in dairy cattle, and Volume 8 of the Register will contain entries of approximately 5,000 of the highest yielding cows of all breeds and types. A copy will be presented free to each member of a milk recording society who records under the Ministry's scheme.

Cost of Milk Recording.—The marked tendency for costs to increase which had been noticed in previous years was checked in the year ended 1st October, 1922, and, as was anticipated, the results for the year under review show a distinct reduction in costs notwithstanding increased activities on the part of societies. About 30 per cent. of the societies have been able to reduce their levies per cow by 6d. or more, and with very few exceptions, societies are in a sound financial condition.

Commercial Value of Milk Recording.—The commercial value of milk recording continued to be demonstrated by the prices realised at sales for recorded non-pedigree cattle and their progeny, and although, as was anticipated, the exceptional prices realised during the boom period of 1921 were not so evident,

STATEMENT giving particulars of 55 Milk Recording Societies operating during the year ended 1st October, 1923.

(The Societies are arranged in order of total number of animals recorded).

NAME OF SOCIETY.	Number of Members.	Number of Herds.	Total No. of animals recorded.	No. of cows recorded for full year.	Av. yield of cows recorded for full year.
					lb.
Essex	215	238	7,902	4,388	7,499
East Sussex	190	229	6,730	3,595	7,311
Hampshire	176	194	6,166	3,251	7,014
Yeovil & Shepton Mallet	150	171	5,404	3,191	6,749
Berkshire	135	150	5,378	2,788	6,845
Hertfordshire	159	178	5,290	2,681	7,200
Kent	163	186	4,974	2,613	7,200
North West Wilts	106	119	4,714	2,736	6,902
Dorset	77	103	4,568	2,720	6,599
Surrey	170	180	4,360	2,174	6,796
Norfolk	144	165	4,253	2,392	7,601
West Sussex	109	119	3,738	1,815	7,255
Oxford	102	109	3,666	1,992	6,950
Salisbury	61	86	3,654	2,338	7,524
Lancashire	131	139	3,574	1,485	6,735
Warwickshire	121	131	3,137	1,604	7,070
Leicester	100	103	2,718	1,447	7,414
Suffolk	107	116	2,513	1,642	7,365
South Devon	97	106	2,452	1,198	6,309
Northants	91	103	2,320	1,271	6,668
Yorkshire	140	141	2,317	1,018	7,333
Shropshire	70	78	2,163	1,383	7,309
Cambridgeshire	83	91	2,150	1,239	7,415
Cheshire	58	64	2,141	1,031	7,152
Cumberland	141	143	2,026	891	6,089
Stafford	71	75	1,837	982	7,519
Nottingham	53	55	1,764	888	6,821
Buckingham	66	71	1,709	835	8,239
Derby	48	51	1,685	809	7,329
Bristol & Bath	76	77	1,537	831	7,281
Deubigh & Flints	70	72	1,459	901	6,685
Worcestershire	62	65	1,416	748	6,948
Peak	57	57	1,266	480	7,004
Warminster & Mere	27	31	1,191	877	6,849
Cadbury	37	45	1,152	761	6,741
Tees Valley	30	37	1,080	438	7,334
East Devon	64	64	1,016	467	6,716
Bedfordshire	36	37	945	510	7,436
Kendal & S'th Westmorland	47	47	856	386	5,841
Frome	20	20	853	567	6,431
Cornwall	50	50	777	446	6,020
North Somerset	31	35	764	473	6,898
Lincolnshire	33	36	755	361	7,175
Anglesey & Carnarvon	60	62	753	432	5,454
Allendale	40	41	741	433	7,034
United Counties	47	48	732	421	6,544
Monmouth	34	36	627	327	6,511
Herefordshire	27	27	620	329	7,026
Campden, Moreton and District	33	33	575	366	6,940
Gloucester & District	32	34	563	295	6,848
Melton Mowbray	26	26	556	295	6,682
Cotswold	25	25	523	359	7,474
Montgomery	23	23	421	223	6,031
Highbridge	15	16	382	226	7,048
Glamorgan	29	29	288	Commenced 1st April, 1923.	
TOTALS	4,365	4,767	127,151	68,349	7,042

it is noteworthy that milk records are much more frequently seen in sale catalogues and asked for in private transactions than was formerly the case.

Advice on Rationing.—Much greater interest has been evinced in the schemes instituted by the County Agricultural Organisers for the economic feeding of dairy cows and butter fat testing. The very useful advice and assistance given by the Organisers are much appreciated and the adoption of balanced and economical rations should prove of great value—financial and otherwise—to members of milk recording societies.

Calf Marking.—The Ministry's Calf and Bull Marking Schemes, the adoption of which is optional, have now been taken up by all but two societies, and interest is steadily growing as members realise the value of officially identifying the progeny of their recorded stock. The number of animals marked under this scheme during the year was 12,647 as compared with 11,517 during the preceding year.

Sheep.—Since 1919 the Ministry has given some financial assistance towards the improvement of Welsh Mountain Sheep. Grants, up to a maximum of £10 for each ram provided, at the rate of 3s. 4d. per ewe served, were made to 14 societies in respect of 17 approved pedigree rams during the year ended 31st March, 1924. The average hiring fee of the rams was £9 13s. and the average service fee 1s. 5d. The number of ewes served was 1,020, an average of 60 per ram.

The scheme, which is in its infancy, promises well, and one excellent result of its operation has been that several members of societies have purchased pedigree rams of their own.

Heavy Horses.—It was possible to revive the grants to Heavy Horse Societies, which were discontinued after 1921 owing to the urgent demand for economy at that time. As the announcement that grants would be available was only made in February last full advantage could not be taken of the scheme for the service season of 1924. It is confidently anticipated, however, that next year it will be possible to continue the good work accomplished by the scheme during the years 1914-1921.

The following are the principal memoranda used in connection with the livestock operations of the Ministry, and copies of them can be obtained free of charge on application to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1 :—

Leaflet 282. Scheme for Improvement of Live Stock.

Leaflet 146. The Value of Records of the Milk Yields of Cows.

No. 609/T.L. Bull Grant Regulations.

No. 392/T.L. Milk Recording Regulations.

No. 466/T.L. Boar Grant Regulations.

No. 89/T.L. Heavy Horse Regulations.

Light Horse Breeding.—The administration of the Light Horse Breeding Scheme was transferred to the War Office on 1st April, 1924, and the following report on the year 1923-24 marks, therefore, the termination of the Ministry's active interest in the scheme which was inaugurated in 1910, and has thus been in existence for 14 years. The operations of the scheme during that period have been described in the annual reports published by the Ministry.

During the year 1st April 1923—31st March, 1924, the scheme was carried on by the Ministry on the usual lines. It was satisfactory that sufficient stallions of the requisite merit were forthcoming at the Thoroughbred Show in 1923 to enable the full number of King's and Super Premiums to be awarded, which was not the case in the preceding year.

Premiums Awarded for 1923 Season.—The following premiums were awarded for the season 1923 :—12 Super Premiums, 48 King's Premiums and 15 Ministry's Premiums (all thoroughbred horses except 3 Ministry's Premiums, which were awarded to 1 Hunter stallion and 2 Cleveland Bay stallions), 5 Riding Ponies, 18 Welsh Cobs, 3 Welsh Roadsters, 4 Dales Ponies, 5 Fell Ponies, 15 New Forest Ponies and 40 to Mountain Pony Stallions in Wales.

Service Season, 1923.—The service season of 1923 showed considerable improvement on that of 1922, the average number of mares served by both the King's and Ministry's premium stallions showing a marked increase. The numbers of mares served by the various classes of stallions were as follows :—

	<i>No. of Mares Served.</i>	<i>Average per Stallion.</i>
12 Super Premiums	966	81
48 King's Premiums	3,437	72
15 Ministry's Premiums	886	59
5 Riding Pony Premiums	208	42

Foaling Results from Service Season, 1922.—The foaling results from the 1922 service season showed a slight improvement on the previous year. The foaling percentage of stallions is calculated upon Returns furnished to the Ministry by the

mare owners, and the results from the 1922 service season were as follows:—

	<i>No. of Mares served in 1922.</i>	<i>No. of Returns furnished to Ministry.</i>	<i>Average Percentage of Foals.</i>
12 Super Premiums ...	855	841	56
45 King's Premiums ...	3,033	2,952	53
15 Ministry's Premiums ...	872	845	54
5 Riding Pony Premiums	205	201	63

The highest percentage (73) was obtained by "Ballyvodock," now owned by Mr. Terry O'Brien, Ballyvodock, Middleton, Co. Cork.

Thoroughbred Show, 1924.—At the request of the War Office the Ministry made the usual arrangements in conjunction with the Hunters' Improvement Society for the Annual Show of Thoroughbred Stallions for the purpose of awarding premiums to stallions for the service season 1924. The show was held at the Royal Agricultural Hall on 4th, 5th and 6th March, and the Judges were Mr. Ernest Bellaney and the Hon. Alexander Parker. The number of entries was 94, seven more than in 1923, and of these 30 were stallions which had not previously been shown. The full number (60) of Premiums (including 12 Super Premiums) was awarded, and the King's Cup was won by "Scarlet Rambler" belonging to Captain T. L. Wickham Boynton and Henry A. Cholmondeley, the Reserve horse being "Gay Lally" belonging to the Compton Stud, thus reversing the positions occupied by these two stallions during the previous three years.

Horse Breeding Act, 1918.—During the licensing year 1st November, 1922, to 31st October, 1923, there was again a marked decrease in the number of stallions licensed under this Act, the number being 2,761 as compared with 3,479 in the preceding year. The proportion of stallions for which licences were refused remained almost the same. There were 136 refusals, 15 of which were after appeal, the numbers for the previous year being 165 and 16 respectively.

Of the 2,761 licensed stallions, 2,512 were pedigree animals and the remaining 249 were horses that were not entered or accepted for entry in any recognised stud book.

The following tables show the number of stallions of each breed concerned that were licensed or rejected, and the number refused licences in respect of the various prescribed diseases or defects:—

NUMBER OF STALLIONS LICENSED OR REFUSED.

<i>Heavy.</i>	<i>Pedigree.</i>		<i>Non-Pedigree.*</i>	
	<i>Licensed.</i>	<i>Refused.</i>	<i>Licensed.</i>	<i>Refused.</i>
Shire	1,568	88	66	3
Clydesdale	185	13	6	1
Suffolk	186	5	1	1
Percheron	47	1	—	—
Others	—	—	61	2
<i>Light.</i>				
Hackney	179	8	30	—
Thoroughbred	140	6	3	—
Arab	22	2	4	—
Hunter	6	—	5	—
Cleveland Bay	7	—	—	—
Yorkshire Coach	2	—	1	—
Welsh Roadster	3	1	1	—
American Trotter... ..	1	—	7	—
Others	—	—	12	—
Ponies (including Welsh Cobs)	166	2	52	3
TOTALS	2,512	126	249	10

* Non-pedigree stallions are arranged as far as possible under types.

NUMBER OF STALLIONS REJECTED FOR THE PRESCRIBED DISEASES AND DEFECTS.

Roaring... ..	29	Defective Genital Organs	2
Whistling	41	Stringhalt	4
Sidebone	21	Shivering	7
Cataract	12	Navicular Disease	1
Ringbone	8	General Unsuitability	1
Bone Spavin	10		
		TOTAL	136

Twenty-three appeals were made against refusals of licences, and in 8 cases these were successful.

Notwithstanding the decrease in the number of stallions licensed the Ministry has information which suggests that the number of unsound stallions which formerly travelled at very low fees, and which constituted the most serious hindrance to the grading up of horse breeding, have been practically eliminated from the road. Since the Horse Breeding Act came into force the Ministry's inspectors and livestock officers and the police have endeavoured to secure observance of the Act by stopping stallions on the road and requiring the production of the licences, and in cases where the regulations have been infringed proceedings have been taken by the police. The fact that the number of prosecutions is steadily declining is evidence of a more general knowledge of and compliance with the Act on the part of stallion owners.

THE FRIT FLY AND ITS RELATION TO THE YIELD OF OATS.*

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DURING recent years we have made considerable advances in our knowledge of the habits of the frit fly, thereby gaining precise information where previously we have had to rely on more or less general impressions. This is the case particularly with regard to the prevalence of the fly in the fields. The fly swarms in the fields three times during the year, first in spring, then in mid-summer and again in late summer. Twice a year, particularly, the oat crop is liable to suffer heavily from this pest. The maggots produced by the spring swarm attack and kill the stems of the oat plants, while those produced by the mid-summer swarm destroy the flowers and the grain.† Obviously then, it has become a matter of importance to know more exactly when an oat crop is likely to suffer maximum damage by the frit fly and also how these periods of possible heavy infestation are influenced by weather and condition of crop, because such information provides a sound basis for the elaboration of preventive measures, direct or indirect.

With this aim, records of the number of frit flies present in the fields day by day, have been collected near Oxford during the period 1919-1922. The procedure followed was simply that of sweeping with a net, regularly and in a definite manner in the oat fields, carefully noting the number of frit flies caught on each occasion. The records collected in 1922 have been expressed in the form of a curve (see chart), to construct which the average number of flies collected weekly was plotted against the corresponding dates of collection. This curve shows clearly the periods of the year when the three generations are present in the field in their greatest numbers. If the chart is carefully examined, in conjunction with the following table, the relation of these generations to each other and to the crop will be readily understood.

	Swarming period of fly.	Approximate date of maximum swarming.	Position of egg and maggot.
Generation III	May to mid-June	May 26	Stem of young oat, other cereal or grass
Generation I	June to mid-Aug.	July 15	Seed of oat, stem of cereal or grass.
Generation II	Aug. to mid-Sept. or later	Aug. 19	Stem of grass or volunteer cereal.

* See "Frit Fly on Oats in the Four Northern Counties," by R. A. Harper Gray, this *Journal*, March, 1923, p. 1109.

† General information about the frit fly may be obtained from the Ministry's Leaflet No. 202.

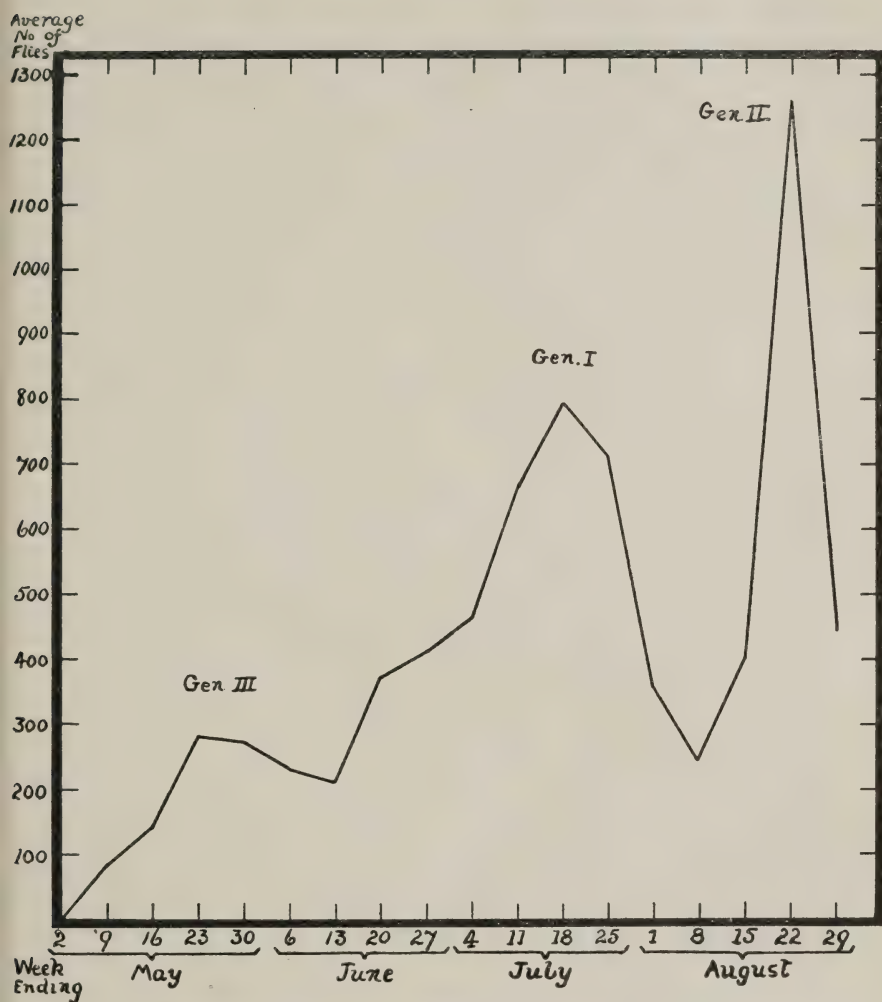


FIG. 1.—Chart showing variations in the Frit Fly Population in the field during 1922.

This curve is almost certainly typical for the southern and midland counties generally, although this is not yet proved to be so by general field observations. It is possible that in more northerly districts the generations will be found to be more sharply defined, which means that the crops would not be menaced by the fly so continuously as they are in the south.

In addition to these facts, we have further information about the times of appearance of these swarms from year to year. Similar field work during the years 1919-1921 has shown that even such pronounced differences in weather conditions as were experienced during the period 1919-1922, failed to move the times of maximum swarming of these three generations of flies outside periods of seven days about the dates indicated in the table. It is this regularity in the times of appearance of the flies in maximum numbers which is of practical importance in relation to the yield from any particular crop of oats, as is explained below.

The August-May Generation.—At any time when a cereal crop is not available the fly deposits its eggs on grasses, and it is important to note that its maggot can exist successfully at any time during the year on at least 15 different species of grass, of which the most important, in order of preference, are common oat grass and its variety, onion couch grass, wall barley, slender foxtail and Italian rye grass. During the winter the fly, in its maggot stage, feeds inside the stems of these and other grasses, and the adult flies from these maggots appear from the end of April to the middle of June, and in maximum numbers about 26th May.*

The flies of this spring swarm must of necessity find suitable breeding places and, roving over the land, they eventually discover cereal or grass stems in fit condition to receive their eggs. The maggots hatching out from these eggs check the growth of the oats in the spring by destroying the internal parts of the stems and when they in turn swarm in the adult state they cause the increase in the fly population shown by the curve in June and July.

The practical importance of the spring swarm depends on the state of growth of the oat crop at the time when the greatest number of flies is present in the field (end of May). In the case of a crop sown early, *i.e.*, during February or March, the

* It is convenient to designate these flies as Generation III, regarding them as belonging to the previous year's cycle, since they are derived from eggs deposited in the autumn.

main stems and early tillers should be well grown normally by the end of May, and therefore would escape infestation;* and only the less important late tillers would suffer from the attack of the maggots. April sowings would naturally produce more stems suitable for the fly, more particularly if growth should be in any way checked during April and May, the loss of crop being correspondingly heavier than in the previous case.

Later sowing would cause the plants to send up main stems eminently suitable for the flies at the time when they would be most numerous in the field; the early death of the main stems would then lead to premature tillering, these secondary stems also being formed at a time when they are liable to heavy infestation, causing severe losses.

If the oat plants are in an unsuitable condition for egg-laying, the flies seek wild grass stems. The succeeding generation (Generation I, of June-July) may still cause damage to the seed of the crop which was more or less immune earlier in the year, especially if the wild grasses occur in the neighbourhood of the oats.

The extent of the damage to the crop in spring depends therefore on the condition of the crop in the latter part of May. The nearer the early growing period approaches the time when the spring swarm is most abundant, the greater will be the loss of stems of seed-bearing value, *i.e.*, loss of crop.

The June-July Generation.—The flies of the June-July swarm may deposit their eggs on late tillers of oats or grass, on the vigorous stems carrying the still concealed developing ears or on the grain in the exposed ear, because the crop generally passes through all these stages while these flies are present in the field. Thus the damage caused by the maggot at this time of year varies; its activity may result in the loss of late but probably unimportant tillers, in the absence of flowers on the ear (blindness) or in the destruction of seed.

The economic importance of the attack on the crop at this stage depends on the relation between the times of seed formation and maximum swarming (about 15th July). When the flowering heads appear early in June, the flowers and the developing grain are exposed to the minimum number of flies, as reference to the chart will show. Even at this time of year the grain may suffer some damage, as there are always some

* The condition of stem which discourages egg laying is now being investigated in collaboration with Mr. J. C. F. Fryer.

flies present in the field; 10 per cent. of seed damage is a low estimate for the Oxford district, even under these comparatively favourable conditions. As the time of shooting of the ears approaches nearer and nearer to the middle of July the extent of the damage to the grain will increase, as the flowers become exposed to an increasing number of flies. Since the maggot is able to attack the seed until the milk stage is reached, the maximum amount of damage may be expected when this range of growth falls about the middle of July; in these circumstances 70 per cent. of the seed may be damaged.

The July-August Generation.—The maggots living in the seed (or other location mentioned above) give rise to the flies which swarm in August (Generation II). Their economic importance lies only in the fact that they are the parents of the spring swarms. They lay their eggs on grasses, the resulting maggots mining in the grass stems until the following spring, when the annual cycle is completed by the swarming of Generation III, which migrates to the oats, if available.

The yield of grain from an oat crop depends on the number of sound vigorous stems capable of producing grain, as well as on the extent of the attack on the grain. It is well known that the liability of the stem to attack decreases rapidly with age, therefore, if the spring swarm appears fairly constantly in time, one would expect early-sown crops to produce sound main stems and early tillers, the later tillers bearing the brunt of the attack but at the same time having small, if any, yield value. A late-sown crop would obviously be liable to attack throughout the greater part of its existence, and the nearer the spring growing period approaches the period of maximum swarming in spring, the greater will be the loss of valuable shoots. The position with regard to the grain is similar; the shorter the time between the periods of seed formation and maximum swarming of Generation I in July the greater will be the liability of the seed to infestation, owing to the increase in population about the middle of July.

Hence we have here the explanation of the necessity for early sowing in the case of spring oats and a reason for the increasing popularity of winter oats in infested districts. The importance of initiating rapid early growth and, when necessary, stimulating growth, is clearly indicated. Varietal differences may, in this connection, be of service to the farmer.

The regularity of the swarming of the fly from year to year is advantageous to the farmer inasmuch as he may take advan-

tage of this fact in regard to the time of sowing, the application of artificial manures to hasten early growth and the selection of varieties, endeavouring always to force the crop beyond the more critical stage by the end of May. Much more research work is required before precise information can be given in relation to these particular points, but considerable knowledge can be acquired by the grower, himself from his own observation.

* * * * *

THE BADGER: ITS HABITS AND LIFE HISTORY.

H. MORTIMER BATTEN, F.Z.S.

Breeding and Young.—The breeding habits of no wild animal have given grounds for so much difference of opinion as those of the badger. Zoologists have been reluctant to accept that the wild, free badger carries her young for so long a period as twelve months, but we know that young badgers are born in the early spring—March and April—and that at the same period sexual excitement among the males is at its height. There are, moreover, numerous cases on record of sow badgers being taken into captivity during late spring and giving birth to cubs the following spring, and all the facts available seem to show that the female mates within a few days of parturition, and so carries her young till the following spring. There are no indications of sexual excitement in the autumn, and I have never heard of cubs being born later than July—such late broods being, of course, the result of a late mating. Again, there are cases on record of captive sow badgers giving birth to cubs after fourteen months in captivity, when there was no possibility of mating during that period, while there are also proven cases of young being born within seven months of mating. It seems possible that captivity may upset the ordinary course of nature where this beast is concerned.

Usually there are two or three cubs to the litter, and they are blind for about a fortnight. They are very attractive little beasts, and until almost full grown can be handled without fear of their biting. Their usual cry consists of a high-pitch squealing, almost identical with the sound created by rubbing one's fingers on a wet sheet of glass.

About the end of June or during July the home burrow is left by the family, and they take up residence in a neighbouring warren—generally within a distance of two miles—leaving the



FIG. 1.—The Badger.

old den to air and sweeten. They—or other badgers—will probably return to it late in the autumn, but badgers invariably move from warren to warren at regular periods, no warren being occupied sufficiently long for it to become verminous and unhealthy. In these ways badgers appear to keep free from those diseases which take such tremendous toll of many less advanced beasts.

Badger warrens exist all over the country, some of them of very considerable antiquity, and our list of place names derived from the badger, such as Brockenhurst and Brockwood, is a long one.

Winter Sleep.—Hibernation is more complete than in the case of the squirrel, and less complete than in the case of the hedgehog. Where badgers are numerous the tracks of restless individuals are to be seen in the snow through the winter, but it may be taken that for every badger astir in December there are a dozen hibernating—unless, of course, the winter be an unusually mild one. In the Highlands, where the badgers belong almost exclusively to the extreme heights, that is to altitudes of 2,000 feet and above, they hibernate in the true sense, though here their strongholds are the immense cairns, which shelter also the fox, the marten cat and the wild cat.

In the autumn the badger sett can always be identified by the great amount of bedding left about the burrows. Fresh bedding is gathered regularly, and when the period of hibernation comes, the burrows are full of grass or bracken as the case may be, in which the animals sleep their winter sleep, and which helps to exclude the draught. Sometimes, but not generally, for the sake of warmth, several of the holes are closed from within when hibernation begins.

Sanitation.—Regarding the cleanliness of badgers anyone who has warrens under observation the year round will observe evidence of the terrific spring-cleaning upheavals which take place, generally in March. The whole warren is then scoured from end to end, and sometimes two or three cart loads of earth and litter are removed from the front entrances. These scouring activities go on to a less extent the year round. The animals are fond of dragging bedding into the warrens, but every week or so the old bedding is dragged out and a fresh, clean supply substituted. Not only this, but badgers never haunt one burrow sufficiently long for it to become foul, changing their quarters every three months or so as previously stated.

Foxes have no sanitation to speak of, and the young are particularly dirty and untidy in their home lives. Badgers, however, reserve a special plot at some distance from the burrow mouth, and that place only do they recognise for the necessary purpose. Droppings are never left inside the burrows, except possibly, in the case of very young cubs whose habits are not formed, and at that time they are in their mother's care.

One can imagine, then, that fox cubs, with all their litter and stink, make very distasteful lodgers for the house-proud badger, yet being slow-footed and a lover of peace, he generally puts up with them.

Food.—I have never known badgers to drag food into their warrens—certainly not the food which would make the warren foul—whereas foxes habitually do. Badgers live chiefly upon vegetable matter—roots of all kinds. Also they eat insects, and fresh meat when it comes to hand during their short-sighted pig-like foragings. Rats and rabbits they especially like, but if a wild badger is watched when out on a foraging expedition it will be observed at once that he is not a hunting animal, since normally he is interested in nothing beyond the radius of a yard from his nose. He will make a weasel-like dash of perhaps twelve feet at anything moving, but he is not very rapid, and knows it, and if that dash fails he goes on with his rooting, the other matter forgotten.

Badgers are not Lamb Killers.—It is sometimes stated that badgers kill lambs. A correspondent in North Wales stated that his good faith in the badger's innocence had been much shaken by the discovery of the remains of lambs in the badger warrens, while prevalent opinion in his part condemned the animal as an habitual lamb killer.

Anyone who has studied the badger at all thoroughly is sure to have come across evidence of this kind, which not uncommonly has sufficient circumstantial strength to result in general warfare against the badger kind, and as the matter is of importance it may usefully be discussed.

It is unwise to say definitely that any wild creature does or does not do a certain thing, since circumstances adjust their habits, and exceptions of all kinds occur. Sometimes a badger escapes from captivity, when if hungry, it will attack almost any kind of live stock. In one case at Gillamoor, North Yorkshire, a wild badger was taken and kept in captivity for about a week, during which time it ate nothing—owing in the first place to the fact that no suitable foods were offered it, and

secondly because a wild badger under any circumstances eats little during its early confinement. The animal broke loose and overturned a coop two hundred yards away, killing the broody hen and eating the sitting of eggs. This was regarded as conclusive proof of the animal's destructive habits, but clearly it was a case of man himself having upset the ordinary course of nature.

On another occasion a badger which had been captive several months got out, and, gaining the keeper's rearing pens, upset several nesting boxes and did a considerable amount of damage during the night; but one has an understanding sympathy for the captive returning thus to plenty and freedom.

However, the North Wales correspondent first referred to clears the badger of guilt in his case by stating that the remains of lambs were found *in the warrens*. A badger never fouls its den in this way, and the work was unquestionably that of foxes, which, having a high appreciation for Brock's wonderful architecture, thrust themselves upon him as uninvited lodgers. It is rare, indeed, to find a badger sett of any size which is without its fox tenants, and I have seen young badgers, young foxes, and young rabbits emerging at sundown from the same warren.

The badger not only has to put up with an untidy lodger, who fouls the burrows which the badger itself tends with Martha-like cleanliness, but, since the fox shadows him everywhere he goes, he forfeits his life as a result of Reynard's crimes.

The killing of lambs by badgers has certainly occurred, but the work of the badger is unmistakable in that he bites the lamb behind the shoulder and invariably leaves it where killed. On the rare occasions when this has occurred, moreover, the shepherds have only themselves to blame for it. Lamb killing in the badger is not natural and instinctive: it is acquired, and the badger which turns lamb killer has acquired the taste through dead lambs having been left about. We need to bear in mind also that the badger is a lover of dense woodland surroundings. He does not favour open country, and will make a considerable detour by the hedgerows rather than cross an open field. Only in wild moorland localities does he venture much into the open, so that the normal badger in a normally wooded locality is exposed to very little temptation in the way of lamb killing.

I have studied the species closely for rather over twenty years, and have enjoyed, I suppose, exceptional opportunities for becoming conversant with its ways, but I have never come

across an instance of lamb killing or anything that suggested the least bent of character in that direction. Naturally I have met many close students of Brock at home, but I have known only two men who claim to have experience in which the badger's guilt was proved. The first was a passing acquaintance. The second was a rural sportsman with sixty years' experience, whose greatest desire was to see the badger given a fair deal, which hitherto the animal has never enjoyed, but he admitted rather grudgingly that well over forty years ago two badgers in his locality—where badgers have always been numerous—killed several lambs ere they were dug out and dispatched. When a beast, about which little is known—and no animal is more the victim of ignorance than the badger—commits a crime, the news of it spreads like bush fire, whereas the normal course of its life is hidden by the shadows we cannot penetrate.

Use of Badger Earths by Foxes.—There is no doubt whatever that foxes harbour better and do better where there are safe earth retreats for them than where there are none, and the badger earth forms the ideal retreat for foxes. This point was proved conclusively by the experiments and experiences of Sir Alfred Pease many years ago, as described in his book on the badger. "Had I had no badgers," says Sir Alfred, "I should have had no foxes." This has been proved over and over again within my own experience. In an agricultural country foxes harbour and remain everywhere that badgers exist, but when the badgers go the activities of the earth stopper slowly but surely causes the old burrows to fall out of use. Foxes cease to frequent the locality for breeding purposes, and naturally become fewer and fewer. Again, it has been found in other parts of the world that with the coming of settlement the foxes become extinct even before the jackals, except where badgers are plentiful. Here the foxes are able to hold their own indefinitely, thus adapting themselves to the changed order.

It is amply proved in every direction that the existence of the badger is beneficial to fox hunting, which makes it difficult to understand why so many huntsmen treat the animal with such disrespect. Badgers have, of course, been known to kill fox cubs, but when we ponder what Mrs. Brock has to put up with from her lodgers it is not to be wondered at that at times her slow-moving anger is roused, and she tries to rid herself of the pests. Still it may be taken that a hundred litters of foxes are afforded safe and ideal nursery quarters by the badger strongholds for every fox cub actually killed by badgers.

The Badger Harmless to Agriculture.—From the foregoing it will be seen that badgers need not enter into our reckonings at all as regards the safety of live stock of any kind, while as concerns hunting interests the presence of a few is undisputably beneficial. These are the two most important points as regards the affairs of those interested in agriculture, for the animal is entirely harmless in its food supplies.

In the Vosges mountains some of the peasants told me that the badgers, which were very numerous, had become destructive to their small holdings by rooting up their vegetable beds, being particularly partial to parsnips, but I have never heard of anything of this kind in Great Britain, where the badger, with his long bill of bitter memories, seeks and haunts only the least frequented hillsides and forest depths.

In Devon and in the Tweed valley I have heard complaints from farmers of the badgers treading down their crops at night time, the whole family assembling to sport and roll where the crops bordered the woodland edges.

The badger is, of course, a very ancient beast, and no wild creature that we have has been so much misunderstood and so unjustly treated. Where it exists any unaccountable occurrence which cannot at once be put down to fox or cat is laid at the door of the badger, for the reason that his ways are unknown, and he is punished accordingly. To me he stands out as the most pathetic figure in all our wild fauna—a lover of peace, seeking ever to avoid contingencies with man, living his retired woodland life on his own quiet lines. Yet glancing back through the history of sport, we find ourselves recommended to “cut away his lower jaw” or to “break off all his teeth” before entering our terriers to him! He is described as stinking and unclean, whereas no wild beast that we have is more free from odour and more cleanly in its way. Again, he has figured in the few of our fables into which he is entered as evil-tempered and morose, but of the many badgers that I have known in captivity all were docile, lovable beasts, and I have yet to know a badger which is one-half as aggressive as the average buck rabbit or jack hare.

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THE ARTIFICIAL LIGHTING OF POULTRY HOUSES.

E. T. BROWN.

THE plan of artificially lighting the laying houses during the winter months is one that has been adopted by a considerable number of poultry-keepers, usually with excellent results. The system, however, being one that tends to force production, calls for careful application; otherwise more harm than good may be done. When care is exercised the results are extremely beneficial in all directions, but there is always a possibility that some poultry-keepers may go to extremes and consequently undo any good that would result.

The main object of lighting the laying houses for a definite period each twenty-four hours is to guarantee every day being of the same duration. Under normal conditions, the birds have less than eight hours of daylight on the shortest day; and during the period of great egg scarcity, that is, November, the days are not quite nine hours in length. It has been suggested that if a bird be inactive for more than ten consecutive hours out of the twenty-four the egg organs are interfered with and the yield is restricted. Whether this theory be correct or not has yet to be proved, but it is an undoubted fact that during the short days of winter heavy laying fowls have not sufficient time to eat and digest the necessary amount of food for the upkeep of their bodies and the formation of eggs. By feeding very highly concentrated and partially digested foods it might be possible to provide the bird's body, during the eight or nine working hours, with sufficient material for these purposes, but it has been found that the digestive system quickly becomes deranged when such a ration is fed. A certain quantity of bulky ingredients is essential to regulate the functions of the various organs concerned.

Methods of Lighting.—To secure the full benefit of this system it is necessary to illuminate the house brightly. The best form of artificial light that can be employed is electric light, but unfortunately this is not available in all cases. The next best is petrol-burning incandescent lamps. These are inexpensive to purchase, while they cost only about one-third of a penny per hour to burn. Acetylene may be used, but is not particularly good, besides being rather costly to instal. When electricity is the lighting agent, two 50-candle-power lamps

should be employed for each house, or section of a house, measuring 30 ft. by 14 ft. In addition, two dimmers—5-candle power lamps are sufficient—are required. If a petrol burning hanging lamp be utilised, one is ample for the same area of floor space. For dimming purposes, two ordinary hurricane lamps can well be employed. There is no necessity to illuminate the whole of the house; the lamps can, therefore, be hung fairly close to the floor. The dimmers, however, should be placed directly over the roosts, so that the fowls will have sufficient light to reach their perches in safety. At the beginning of the laying season, the dimmers should be burnt for a quarter of an hour; in a few days, however, the birds will become so accustomed to the routine that they will all be roosting within four or five minutes after the main lights are switched off.

When to Light up.—Opinion is divided as to the best time to light the houses artificially. In some instances, when electric light is employed, the lights are automatically turned on at 5 a.m., and switched off at daylight. They are then lit up again at dusk and switched off at 7 p.m. Again, the house may be lighted as soon as it begins to grow dusk and the light turned out at such an hour as will give a twelve to fourteen hour day, without using artificial light in the morning. In the middle of October the sun rises about 6.20 a.m.; therefore the light should be kept burning until 8.20 p.m. Each night the time will get later, until on December 21st, when the sun rises a few minutes after 8 a.m., the artificial lighting would have to be continued until 10 p.m. A third plan, and one which has been found to give as good results as either of the two foregoing, is to allow the birds to go to roost in the normal way, lighting the house up at 7 p.m. and leaving it illuminated as long as necessary. If the first plan be adopted, the first feed of the day—the grain ration buried in the litter in the scratching shed—would have to be scattered at night, since under commercial conditions the length of the working day for the assistants should not be prolonged too much. The last feed would be given regularly about 5.30 p.m., as the lights would be turned off at 7 p.m. each day. When the houses are only lighted during the evening, the birds should be fed according to the usual plan; that is, the last feed should be given about 3.30 p.m. or 4 p.m. An additional light scratch feed must also be given to provide the birds with the extra nourishment they require for heavy production. In both of the two latter cases this is best given at 7 p.m. This scratch feed should not be looked upon in the light of a proper meal;

only a small quantity is necessary to supply the extra raw material needed for the formation of the eggs. The great advantage of making this last meal a scratch feed is that those birds which require the most food, that is, are laying the heaviest, will have an opportunity of securing sufficient. A pound and a half of grain is ample for 50 layers, no matter whether they be light or heavy breeds. This allows roughly $\frac{1}{2}$ oz. per bird. The body requirements of heavy breed birds are, of course, greater than those of light breed birds, but this additional evening meal is intended only as a source of supply of raw material for egg production. The difference of the body needs is provided for by the slightly heavier rationing of the heavy breed birds during the day. Three parts of wheat and one part of kibbled maize make a suitable scratch feed for this meal.

The Results on Egg Production.—The chief result of artificially lighting the layers' houses is that winter egg production is increased very considerably. It is extremely difficult, at this stage, to give any definite statistics relative to the increase noted, since other factors may also contribute to the result. Even the reports which have been published concerning laying tests, in which a number of the flocks have been maintained under this system, do not help materially towards arriving at definite conclusions in figures. It is undoubted, however, that the rate of winter egg production is increased, but it appears to be equally correct that the total annual yield from the flock is in no way—or very slightly—influenced. If, however, it is possible to increase the winter yield by one-third greater when artificial light is employed than under normal conditions, as has been proved in some instances, and the profit from each member of the flock must be higher, since in the ordinary course of events these extra eggs would have been laid in the spring and early summer when the price is low. If the result be to increase the output from each layer by only 12 eggs during October, November and December—and this is a very low estimate—the difference between autumn and spring prices of eggs will give an extra gross profit of 2s. 9d. per bird.

The second result of importance to be noticed is that this system encourages the layers to pass into a short, light moult early in March. It is not suggested that all the layers will moult at this time, but those which have proved to be the heaviest layers generally comply with this rule. The duration of the moult, however, is only brief, not lasting more than four weeks at the outside. Some birds will continue to lay during

this period, although less regularly than earlier in the season, but this cannot be relied upon. This enforced rest instead of being a disadvantage is in reality a benefit. During this time the birds are able to recuperate after some months of very heavy production, and it is remarked that afterwards they lay at rather more than normal rate until the moult proper is due. In this way, although the total annual egg yield may not be increased, the eggs are produced at those periods when prices range higher than those obtained at the cheapest season of the year. It is for this reason that no attempt has been made to counteract the moult resulting from the use of artificial light. It should be possible to prevent the birds falling into this light moult in March, but in the opinion of the writer the rest is beneficial rather than otherwise.

It has been suggested that the use of artificial light in the laying houses tends to force production. This fact must be borne in mind and a beginning must not be made too early in October. If pullets which would not come into lay for two or three weeks under normal conditions are subjected to this process, the egg organs become active almost at once. Such an occurrence, however, should be avoided, since to encourage production unduly at this stage of a bird's life will probably stunt its growth, induce a continuance of the production of small eggs and in other ways injure it as a money-making machine. Pullets should only be passed into the illuminated laying house when they reach maturity and are ready to start work.

For the same reason the houses of the breeding pens should not be lighted. In this case it is desirable to secure a moderate number of strongly fertilised eggs rather than an increased number produced by forcing. It is quality not quantity that should be striven for. If breeders who sell eggs for hatching and day-old chicks attempt to force production in the breeding pens, they are not acting in the best interests of their customers; hence artificial lighting should not be employed.

Conclusions.—The success of this system, as a means of increasing the winter production of eggs, depends largely upon the quality of the stock which are subjected to it. To withstand successfully the undoubtedly baneful effects of forcing methods, the birds must be possessed of perfect health, a high standard of vigour, unimpaired vitality, and be bred along right lines and fed and otherwise managed correctly. The digestive system of the bird must work proportionately at the same speed as the egg organs, and therefore particular care must be paid to the quality

and nature of the rations supplied. The limitation of the working hours of the day to a maximum of fourteen is essential; to increase the hours of light to fifteen or above is productive of inferior results, as is always found when extreme measures are adopted. When working with good quality stock, however, which are treated in the manner indicated above, the lengthened day proves distinctly beneficial both to the health of the flock and to the egg yield. The egg yield, although increased, is not by any means abnormal. The egg organs are not called upon to work any harder than they do naturally in the spring of the year when egg production is normally at its highest. The lengthened day simply allows the birds to eat the necessary quantity of extra food for the manufacture of their eggs and does not induce abnormality in any direction.

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SEPTEMBER ON THE FARM.

J. R. BOND, M.B.E., M.Sc., N.D.A. (Hons.),
Agricultural Organiser for Derbyshire.

Seed Wheat.—In preparation for the approaching sowing season, problems regarding wheat seed require consideration during the present month. If no question about change of variety be raised, the farmer has still to decide whether to sow seed grown on his own farm or to introduce new seed, and if the latter, whence to obtain it.

The practice of changing the seed every few years is widely adopted; it has been observed for centuries; and the view is held that the best sources from which to obtain new seed wheat are clay or chalk soils in early districts. The practice rests upon the belief that repeated cultivation of a variety under the same conditions causes it to degenerate or "run out," and in consequence to lose cropping power, quality and other characteristics such as earliness. It is open to question, however, whether frequent change of seed is an important factor in wheat production, apart from the possibility of the "new seed" being a better sample than the home-grown corn.

Degeneration, apart from mixing with other varieties such as may be introduced by the thrashing mill, does not normally occur in established sorts of wheat, as this plant is self-fertilised. A most exhaustive test on this point was conducted at Garforth (Leeds University Farm) in the years 1899-1913.

Squarehead Master wheat was grown successively for 15 years in comparison with new seed of the same variety and with once-grown seed. The results of the 14th and 15th years of the tests, which were typical of the whole, were as follows:—

Year.	Seed.	Yields per acre.				Weight per bus.
		Grain (bus.)			Straw. (cwt.)	
		Saleable.	Seconds.	Total.		
1913	New.	49 $\frac{1}{2}$	2	51 $\frac{1}{2}$	42	62 $\frac{1}{2}$
	2nd time grown.	47 $\frac{3}{4}$	1	48 $\frac{3}{4}$	40 $\frac{1}{4}$	62 $\frac{3}{4}$
	15th " "	47 $\frac{3}{4}$	1 $\frac{1}{2}$	49 $\frac{1}{4}$	38 $\frac{1}{2}$	62 $\frac{1}{2}$
1914	New.	30 $\frac{1}{2}$	3	33 $\frac{1}{2}$	32 $\frac{1}{4}$	60 $\frac{1}{4}$
	2nd time grown.	30	3 $\frac{1}{2}$	33 $\frac{1}{2}$	31	60 $\frac{1}{4}$
	14th " "	28	3 $\frac{1}{4}$	31 $\frac{1}{4}$	29 $\frac{1}{4}$	60 $\frac{1}{4}$

Experiments on similar lines were conducted at Wye College farm in the years 1919 to 1922, using five varieties. The conclusion from these was:—"So far there is no evidence of deterioration in the home-grown seed. Taking the average of all the plots, the home-grown seed gives a slightly larger yield than the new seed." The home-grown seed was always very carefully dressed before sowing.

To test the influence, if any, of the district of origin of seed, the writer began a series of trials in Derbyshire in 1920. The results in a typical example from the 1921-2 trials may be quoted. The variety was Marshal Foch.

Plot.	Source of seed.	Corn, bus. per acre.			Straw. Cwt. per acre.
		Best.	Seconds.	Total.	
1.	Home-grown.	44 $\frac{1}{3}$	2 $\frac{2}{3}$	45	42
2.	Essex.	40 $\frac{1}{3}$	2 $\frac{2}{3}$	41	37 $\frac{1}{3}$
3.	Lincolnshire.	38	1 $\frac{1}{2}$	38 $\frac{1}{2}$	35
4.	Scotland.	39 $\frac{2}{3}$	1	40 $\frac{2}{3}$	37 $\frac{1}{3}$
5.	Home-grown.	42 $\frac{1}{2}$	1	43 $\frac{1}{2}$	42

The writer's conclusions from the Derbyshire trials are that the quality of the individual sample of seed is of more importance than its source. Seed wheat should be well matured, harvested under good conditions, and thoroughly dressed to remove small grains.

The question as to whether a change of seed is desirable depends upon the quality and dressing of the home product. The latter may have become considerably mixed with other varieties differing in class of grain and in date of maturity. In a given year the crop may have grown and ripened irregularly, become lodged, or been subjected to bad harvesting conditions. In late districts and with certain heavy yielding but slow maturing varieties, such as Iron and Iduna, the local seed may not be sufficiently well ripened and conditioned for re-sowing.

There is always some risk of the seed being infected with *Cladosporium* disease after a wet harvest, the result of which is a thin plant, liable to perish in the winter. Home-grown corn secured under such conditions should be subjected to a germination test before being adopted for seed.

In the year 1920-21, following the wet harvest of 1920 in Derbyshire, the writer observed some striking examples of the advantage of good new seed obtained from the southern counties. In one case the plant from home-grown seed completely died away in the winter, while an adjoining plot of new seed sown on the same day grew well and made a full crop.

Matted Pastures.—In the March issue of this *Journal* attention was called to the mechanical treatment of certain types of grassland that give little response to manurial dressings. A still less responsive type of pasture occupies large areas in the northern midlands, especially on coal measures clays, but also on light dry soils. On pastures of the type about to be described, basic slag may be applied in very heavy dressings without producing any visible effect, although on adjoining pastures slag may act like a charm.

The type of pasture in question is that in which there occurs a "mat" of dead but incompletely decayed fibrous matter between the soil and the green herbage. The dominant grass—clover is absent—is usually creeping bent, and the other herbage may be sorrel, bed-straw, yarrow and such other plants as are capable of enduring soil acidity. The bent grass forms a close sward; but the pasture is unpalatable, late and unproductive. In the matted condition such land has very little grazing value.

The treatment necessary to remove a mat, and thus prepare the way for the action of phosphatic dressings, depends on the thickness of the fibrous layer, which may be several inches. In mild cases, the following method answers well:—in autumn, apply lime and harrow vigorously; next spring apply a complete dressing of artificials; and in the following winter apply phosphates. The inclusion of nitrogen in the first dressing of artificials promotes decay of the mat, probably in the same way as does the use of nitrogenous compounds in the process of rotting straw into artificial yard manure. If the pasture can for one year be treated as a meadow—manured and mown—the initial improvement will be hastened; also the application of yard scrapings and similar earthy matter is beneficial. As

the mat rots away, white clover begins to appear and spread; and while the clover remains no mat will again form: an occasional dressing of slag, with potash, if necessary, will keep the clovers in possession of the ground.

Pastures covered with a thick mat require drastic treatment. Many such fields were broken up during the food production campaign (1917-19) and a great many of them failed to produce a crop in the second year, the blame being generally laid upon wireworm; the symptoms of lime-failure strongly resemble wireworm attack.

A thick mat cannot be got rid of within several years without the use of the plough; but it is not necessary to incur the risk of a succession of crop failures by putting the broken-up land through a rotation of crops before seeding down again. This was a lesson learnt from the food production campaign. Grass and clover seeds will "take" and establish themselves on the back of a flat furrow ploughed out of old matted pasture, provided that lime be applied some months previously and a suitable tilth be obtained. The use of wild white clover in the seeds mixture is of special importance in this case, while the application of phosphates conduces to its early establishment.

In August, 1920, a field of badly matted pasture in the Belper district was ploughed up for improvement in accordance with the above principles. It was limed and sown with rye in the following month and in the spring of 1921 slag was applied and a simple permanent mixture sown. The "seeds" came well; the rye was in due course harvested as a corn crop; and the young pasture, now in its third year, has every appearance of forming a good permanent turf.

Milk Recording.—Recording the milk yield of each cow in the herd is gradually gaining recognition as a considerable aid to the good management of a dairy farm. As yet, however, only about one farmer in twenty records his cows, and among those who do keep records there are many who derive little benefit from the practice. To realise fully the advantages of recording, the information afforded by the weighing sheets must be extracted and utilised to criticise the performance of each cow and to serve as a guide in feeding and breeding.

Weekly weighings serve as an approximate indication of the productivity of each cow. Recording at each milking, however, gives valuable further information: it reports any sudden depression in the yield of a beast, thus leading to inquiry as

to the cause—ailment or bad milking; it also serves as a basis for correct rationing, which is most essential to economical milk production, especially in winter.

The milk and food-cost records of any herd become more interesting to the owner when they are compared with those of other similar herds, as by such comparisons important points in management may be brought out. In herd A, it may be observed, for instance, that good cows maintain their maximum yield of 4, 5 or more gallons per day for a considerably longer period than do cows in herd B, which fall off in yield rapidly after about their eighth week of lactation. The owner of herd B, probably does not give his "flush" cows their proper share of the concentrated foods fed.

The more progressive milk recording societies play an important part in directing attention to the value of correct rationing. So far as the writer is aware, however, no society takes into account the quantity and cost of the nutriment consumed by the various herds entered in the herd competitions organised by such society.

The cost of being a member of a milk recording society varies from 3s. to 5s. per cow per annum. The next recording year begins on 1st October.

* * * * *

MONTHLY NOTES ON FEEDING STUFFS.

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Scientific Feeding Standards and Feeding Practice.—The feeding of stock has always been acknowledged to be one of the most interesting features of agricultural practice, since the condition of a farmer's stock reflects more than anything else on the farm his capacity to farm successfully. The stockfeeder prides himself upon his ability to produce economically a beast that suits the local market, and he knows that that pride is not misplaced when the local butcher begins almost to haunt the farm in his anxiety to purchase some fat stock. Methods of feeding stock vary considerably from district to district, and it is evident that local conditions determine to a large extent the feeding methods adopted. Thus, in the eastern counties it is not uncommon for stock to consume daily up to $1\frac{1}{2}$ cwt. of roots per head. In the midlands, on the other hand, the writer has met very successful stockfeeders who have told him that it is unsound practice to feed more than 35 lb. of roots

a day. In the south-eastern counties, again, it is held that the maximum amount of roots that can be fed with economy is 75 lb. per day. Now, just as the housewife treasures up in a commonplace book recipes of table dainties culled from many sources, so the stockfeeder treasures up recipes of mixtures and methods of feeding that he and his forbears have found to be successful. While such methods are of value, the extent of their application to general practice is necessarily limited, and such stockfeeders find themselves on unsafe ground the moment questions of cost compel them to depart from their well-tried mixtures and experiment with unfamiliar but cheaper feeding stuffs.

It is at this point that the scientist is of value. The scientist has endeavoured to establish a quantitative relationship between the amount of food given to an animal and the effect that food will produce, whether in the form of meat, milk, or work. This problem has received consideration from the scientific investigator for nearly a hundred years, and it can be stated with confidence that, although the problem is not solved in all its aspects, sufficient is known to be of real service to the stockfeeder. The results of such investigations have been translated into scientific feeding standards, and such standards are used by many stockfeeders in this country. Hitherto, stockfeeders have chiefly made use of standards of rationing for dairy cows, the standards for fattening stock having proved too unwieldy and inelastic to be of general application to ordinary feeding practice. The trouble hitherto has been that the stockfeeder is feeding for a definite object which will vary with local conditions and local markets, and a fixed feeding standard is therefore inapplicable. Professor T. B. Wood, whose name is familiar to all stockfeeders, has devoted much time and energy to the solution of this problem, and in his book* has evolved a method of computing rations according to the result which the feeder desires to produce. Professor Wood has kindly promised the writer that he will outline, in future issues of these Notes, the methods whereby stockfeeders can compute the rations they should feed to produce economically the result they wish to attain.

Farm Values of Home-Grown Feeding Stuff.—A correspondent has inquired as to the method of arriving at the price per lb. starch equivalent of the home-grown feeding stuffs given in the table, and what is meant precisely by value per ton on farm, since he finds no apparent relation between such

* Animal Nutrition, T. B. Wood, F.R.S., Univ. Tutorial Press.

DESCRIPTION.	Price per Qr.		Price per		Manurial Value per Ton.	Cost of Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv.	Price per lb. Starch Equiv.
			Cwt.	Ton.					
	s. d.	lb.	s. d.	£ s.	£ s.	£ s.		s.	d.
Wheat, British - -	—	—	13/6	13 10	0 15	12 15	71·6	3/7	1·92
Barley, Canadian, No. 3	—	—	—	—	—	—	—	—	—
Western	42/-	400	11/9	11 15	0 12	11 3	71	3/2	1·70
" Karachi - -	41/6	"	11/7	11 12	0 12	11 0	71	3/1	1·65
" Russian - -	41/6	"	11/7	11 12	0 12	11 0	71	3/1	1·65
Oats, English, White -	—	—	10/8	10 13	0 13	10 0	59·5	3/4	1·78
Canadian:—	—	—	—	—	—	—	—	—	—
No. 2 Western	30/9	320	10/9	10 15	0 13	10 2	59·5	3/5	1·83
No. 3 " - -	29/9	"	10/5	10 8	0 13	9 15	59·5	3/3	1·74
Feed - - -	28/3	"	9/11	9 18	0 13	9 5	59·5	3/1	1·65
" Argentine - -	26/-	"	9/1	9 2	0 13	8 9	59·5	2/10	1·52
" Chilian - - -	25/6	"	8/11	8 18†	0 13	8 5	59·5	2/9	1·47
Maize, Argentine - -	41/-	480	9/7	9 12	0 13	8 19	81	2/2	1·16
Beans, Rangoon - - -	—	—	11/-	11 0†	1 11	9 9	67	2/10	1·52
Peas, Japanese - - -	—	—	21/-	21 0†	1 7	19 13	69	5/8	3·04
Millers' Offals:—	—	—	—	—	—	—	—	—	—
Bran, British - -	—	—	—	7 2	1 6	5 16	45	2/7	1·38
" Broad - - -	—	—	—	8 2	1 6	6 16	45	3/-	1·61
Middlings—	—	—	—	—	—	—	—	—	—
Coarse, British	—	—	—	9 12	1 1	8 11	64	2/8	1·43
Pollards, Imported - -	—	—	—	7 17†	1 6	6 11	60	2/2	1·16
Meal, Barley - - -	—	—	—	12 15	0 12	12 3	71	3/5	1·83
" Maize - - -	—	—	—	10 15	0 13	10 2	81	2/6	1·34
" " Germ - - -	—	—	—	10 5	0 18	9 7	85·3	2/2	1·16
" " Gluten Feed	—	—	—	9 12	1 6	8 6	75·6	2/2	1·16
" Locust Bean - -	—	—	—	9 0	0 9	8 11	71·4	2/5	1·29
" Bean - - -	—	—	—	13 0	1 11	11 9	67	3/5	1·83
" Fish - - -	—	—	—	18 10	4 3	14 7	53	5/5	2·90
Linseed - - -	—	—	—	22 17	1 10	21 7	119	3/7	1·92
" Cake, English	—	—	—	—	—	—	—	—	—
12% Oil	—	—	—	14 15	1 17	12 18	74	3/6	1·87
" 10% Oil	—	—	—	14 2	1 17	12 5	74	3/4	1·78
" 9% Oil	—	—	—	14 0	1 17	12 3	74	3/3	1·74
Cottonseed Cake, English	—	—	—	—	—	—	—	—	—
5½% Oil	—	—	—	8 15	1 13	7 2	42	3/5	1·83
" Egyptian	—	—	—	—	—	—	—	—	—
5½% Oil	—	—	—	8 10	1 13	6 17	42	3/3	1·74
Decorticated Cotton	—	—	—	—	—	—	—	—	—
Seed Meal 7% Oil -	—	—	—	13 2†	2 12	10 10	71	3/-	1·61
Palm Kernel Cake 6% Oil	—	—	—	8 15	1 2	7 13	75	2/-	1·07
Meal 2% Oil - - -	—	—	—	7 15	1 3	6 12	71·3	1/10	0·98
Feeding Treacle - - -	—	—	—	8 2	0 8	7 14	51	3/-	1·61
Brewers' Grains:—	—	—	—	—	—	—	—	—	—
Dried Ale - - -	—	—	—	8 7	1 3	7 4	49	3/-	1·61
" Porter - - -	—	—	—	8 0	1 3	6 17	49	2/10	1·52
Wet Ale - - -	—	—	—	1 5	0 9	0 16	15	1/1	0·58
" Porter - - -	—	—	—	0 19	0 9	0 10	15	-/8	0·6
Malt Culms - - -	—	—	—	8 0†	1 13	6 7	43	3/-	1·61

† At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of July and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £1 2s. per ton. The food value per ton is therefore £8 18s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 12s. 5d.; P₂O₅, 4s.; K₂O, 2s. 6d.

value per ton and the market price of that commodity. Nor apparently is there any relation between this value per ton and the cost of production, nor even the valuer's "consuming value." The object of this table is to give farmers a price value per ton of home-produced feeding stuffs. This price represents the value of this commodity per ton *if consumed on the farm* as compared with the value of a similar number of units of starch equivalent purchasable in the open market. Thus, if the farm value of potatoes per ton is given as £2 19s. 0d. it means that the same amount of feeding value as a ton of potatoes contains can be purchased in the open market in the form of maize for £2 19s. 0d. The figure is of value in two ways. Firstly, if the cost of production per ton of potatoes is known, the farmer will know whether he is producing this feeding stuff at a cheaper rate than he can buy feeding stuffs in the open market, and, secondly, if he cannot sell his potatoes for more than the feeding value given it will pay him better to feed them to his stock since he cannot buy their feeding value more cheaply in open market. On the other hand, if he can get, say, £4 per ton for his potatoes sold off the farm he will obviously be making a profit by selling and buying in an equivalent amount of feeding value, say, in the form of maize at the price quoted in the table.

The price per lb. S.E. (starch equivalent) in column 1 is the price per lb. of S.E. of a food of comparable value given in the Market Prices table. Thus, for potatoes and roots, maize is taken as a basis of comparison; for hay, dried brewers' grains; and for silage, an average between these two figures. It is not claimed that this basis of comparison is scientifically correct, but it is felt that the basis comparison used is sufficiently accurate to be of value in assessing the price of the feeding values of home-produced foods.

FARM VALUES.

CROPS.	Market Value per lb. S.E.	Value per unit S.E.	Starch Equivalent per 100 lb.	Food Value per Ton.	Manurial Value per Ton.	Value per Ton on Farm
	d.	s. d.		£ s.	£ s.	£ s.
Wheat - - - -	1.16	2 2	71.6	7 15	0 15	7 0
Oats - - - -	1.16	2 2	59.5	6 9	0 13	5 16
Barley - - - -	1.16	2 2	71.0	7 14	0 12	7 2
Potatoes - - - -	1.16	2 2	18.0	1 19	0 3	1 16
Swedes - - - -	1.16	2 2	7.0	0 15	0 2	0 13
Mangolds - - - -	1.16	2 2	6.0	0 13	0 3	0 10
Good Meadow Hay - -	1.61	3 0	31.0	4 13	0 13	4 0
Good Oat Straw - -	1.61	3 0	17.0	2 11	0 6	2 5
Good Clover Hay - -	1.61	3 0	32.0	4 16	1 0	3 16
Vetch and Oat Silage - -	1.39	2 7	14.0	1 16	0 7	1 9

PRICES OF ARTIFICIAL MANURES.

OTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	Average Price per ton during week ending August 20th.				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
Nitrate of Soda (N. 15½ per cent.)	£ s. 14. 5	£ s. ...	£ s. 13.12	£ s. 13.12	s. d. 17. 7
" " Lime (N. 13 per cent.) ... ..	... ..	12.10	...	12.10	19. 3
Sulphate of Ammonia, ordinary (N. 20.7 per cent.)	12.17*	12.17*	12.17*	12.17*	(N)12. 5
" " " neutral (N. 21.1 per cent.)	14. 0*	14. 0*	14. 0*	14. 0*	(N)13. 3
Kainit (Pot. 12½ per cent.) ... ..	...	...	...	2. 2	3. 5
French Kainit (Pot. 14 per cent.)	2.10	2. 3	2. 5	2. 5	3. 3
" " (Pot. 20 per cent.) ... ..	...	2. 7	...	2.10	2. 6
Potash Salts (Pot. 30 per cent.) ... ..	...	...	...	3.15	2. 6
" " (Pot. 20 per cent.) ... ..	...	...	2.10	2. 7	2. 4
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	6.15	7.10	6. 7	2. 7
Sulphate of Potash (Pot. 48 per cent.) ...	...	11. 5	11.10	11. 0	4. 7
Basic Slag (T.P. 30 per cent.) ... ..	...	...	2.12§	...	1. 9
" " (T.P. 28 per cent.) ... ..	...	2. 1†	...	2.10§	1.10
" " (T.P. 26 per cent.) ... ..	...	1.14†	...	2. 8§	1.10
" " (T.P. 24 per cent.) ... ..	...	1.11†	2. 0§	2. 6§	1.11
Superphosphate (S.P. 35 per cent.) ...	4. 4	...	3.15	3. 5	1.10
" " (S.P. 30 per cent.)	3.16	3. 7	3. 8	2.19	1.11
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9. 0	8.10	8.10	8. 0	...
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	6.17†	6.10†	6. 0	6. 5†	...
Fish Guano (N. 7½-8½, T.P. 16-20 per cent.)	12.15	...	13. 0	...	...
" " (N. 9, T.P. 10 per cent.) ... ..	...	...	...	13. 0	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named.

THE following grades of milk are recognised under the Milk and Dairies (Amendment) Act, 1922:—(1) "Certified," (2) "Grade A Tuberculin Tested," (3) "Grade A," and (4) "Pasteurised."

The Recognised Grades of Milk.

There is also ordinary milk (ungraded) for which the price ruling for "milk" at the moment has to be paid. The first and most expensive class of milk is Certified Milk, which is obtained from special dairy herds which are under regular veterinary inspection, and which are found not to react to the tuberculin test. This milk must be bottled on the farm, must be sold in the raw (*i.e.*, unpasteurised) state, and must not contain more than 30,000 bacteria to one cubic centimetre, or show the presence of *Bacillus Coli* in one-tenth cubic centimetre on delivery to the customer. It is obtainable

from most milk retailers, though it can only be produced on a farm for sale as Certified Milk if a licence has first been obtained from the Ministry of Health.

The second class of milk—"Grade A Tuberculin Tested"—is produced from cows which are subject to veterinary inspection and do not react to the tuberculin test. It must also be sold in the raw state. It differs from Certified Milk in that it may be sent by rail in sealed churns to be bottled at the dealer's premises, and must not contain more than 200,000 bacteria per cubic centimetre and *Bacillus Coli* must not be present in one-hundredth of a cubic centimetre on delivery to the consumer. A licence for its production is also obtainable from the Ministry of Health.

Plain "Grade A" milk is produced from cows which are also subject to veterinary inspection; it may be sent by rail in sealed vessels to be bottled on the dealer's premises, and may be sold either in the raw state as "Grade A" milk, or after pasteurisation as "Grade A Milk Pasteurised." If it is sold in the raw state it must not contain more than 200,000 bacteria per one cubic centimetre, or show the presence of *Bacillus Coli* in one-hundredth of a cubic centimetre on delivery to the consumer. If it is sold as "Grade A Milk Pasteurised" it must be retained at a temperature of not less than 145 degrees F., and not more than 150 degrees F., for at least 30 minutes, and must then be immediately cooled to a temperature of not more than 55 degrees F. Such milk must not contain more than 30,000 bacteria per one cubic centimetre, and must not show the presence of *Bacillus Coli* in one-tenth of a cubic centimetre on delivery to the consumer. Licences for its production can be obtained from the local authority.

"Pasteurised Milk" is milk which has been pasteurised under certain specified conditions, and must contain not more than 100,000 bacteria per one cubic centimetre. The milk must not be pasteurised more than once and must not otherwise be treated by heat. Licences to produce this milk can also be obtained from the local authority.

* * * * *

A POULTRY conference is to be held at the Midland Agricultural and Dairy College, Sutton-Bonington, Loughborough.

Poultry and Pig on 23rd September, and it is hoped that
Conferences. the following will take part:—

Dr. F. A. E. Crew, Director, Animal Breeding Research Department,
Edinburgh University—"Some Breeding Problems."

Captain J. P. Rice, B.Sc., Head of the Division of Animal Diseases, Stormont, Belfast—"The Prevention of Poultry Diseases."

Captain N. Bisset, Veterinary Adviser, Cardiff University—"Disease Problems."

A pig conference will be held at the college on 25th September, when discussion will be opened by the following:—

W. A. Stewart, M.A., Principal, Moulton Farm Institute, Northampton—"The Bacon Pig and Breeding for Bacon."

Dr. Charles Crowther, Principal, Harper Adams Agricultural College, Newport, Salop—"The Feeding of Pigs."

Dr. A. G. Ruston, Lecturer in Economics, Agricultural Department, The University, Leeds—"The Case for a Bacon Factory."

The Chief Organiser of the Agricultural Organisation Society—"The Financial Organisation of a Bacon Factory."

B. E. Brighton, The Co-operative Bacon Factory, Ruskington, Lincs.—"The Farm and the Factory."

* * * * *

THE Ministry of Agriculture has, with the concurrence of the Development Commissioners and the Treasury, made the **Special Grants for Agricultural Research** of agricultural research into specific problems during the academic year 1924-25:—

<i>Institution.</i>	<i>Subject.</i>	<i>Amount of Grant.</i>
University College of Wales, Aberystwyth	Nutritive Value of Grasses	£ 250
Do.	Marketing in Breconshire ...	150
University College of North Wales, Bangor	Dry Rot of Swedes ...	165
Do.	Measurement of Evaporation and Drainage	62
Do.	Intestinal Parasites of Sheep	190
Imperial College of Science and Technology... ..	Change of Seed in Potatoes	60
Do.	Mosaic Disease of Hops ...	160
Leeds University	Colour of Wensleydale Sheep	200
Do.	Potato Disease (Internal Rust Spot)	220
Midland Agricultural and Dairy College	Solids-not-fat Contents of Milk	250
South Eastern Agricultural College, Wye	Flea Beetles	200
East Malling Research Station	Raspberry Diseases ...	250
London School of Economics ...	Crop Returns and Prices during the 13th, 14th and 15th centuries	125
University College, Reading ...	Soil Survey of Berkshire ...	100
University College, London ...	Control of Sex Proportion in Mammals	150
School of Agriculture, Cambridge	Soil Moisture and Air Earth Currents	265
[Institute not settled]	Eel Worm in Potatoes ...	250

£3,047

THE preliminary tabulation of the Agricultural Returns collected on 4th June, 1924, in respect of agricultural holdings above one acre in England and Wales shows that the total area under crops and grass is 25,873,000 acres, comprising 10,928,000 acres of arable land and 14,945,000 acres of permanent grass. The total area of crops and grass is 70,000 acres less than the area returned in 1923, while the area of rough grazings has increased by 56,000 acres; the total area of land coming within the scope of the Returns is thus 14,000 acres less than in 1923. As regards livestock, the decline in the number of horses continues, but all other classes again show an increase, the rise in the case of pigs being remarkable.

As compared with 1923, the arable area has fallen by 253,000 acres, and permanent grass has increased by 183,000 acres. The area of arable land is now practically the same as in 1914.

Cereals.—The area under wheat again shows a substantial decline, and this year's decrease of 194,000 acres brings the area of this crop to the lowest figure since 1904. Part of the reduction this year is probably attributable to the very unfavourable weather conditions at seeding time last autumn. Barley shows a relatively small decline of 11,000 acres, while oats and mixed corn have increased by 57,000 and 18,000 acres respectively. The total area of the three chief cereals, including mixed corn, is 5,032,000 acres, this being 130,000 acres less than in 1923.

Beans and Peas.—These crops, the area of which fell substantially last year, show some recovery, beans having increased by 6,000 and peas by 30,000 acres; the latter is now well above the average, but the area of beans is still below the figures recorded in many recent years.

Potatoes.—The area of potatoes, which fell heavily last year, shows a further decline of 15,000 acres, small decreases being fairly general throughout the country, though none of the principal potato-growing districts show any marked change.

Roots.—The area under turnips and swedes has on the whole shown a downward trend for many years past, and with a reduction of 30,000 acres, the area of 832,000 acres this year is the lowest on record with the exception of that of 1922. The area of mangolds at 390,000 acres, shows a decline of 13,000 acres, and this year's acreage is rather under the average.

Fruit.—The area of orchards is returned at 239,000 acres, this being an increase of 7,000 acres over last year's area.

Small fruit at 73,000 acres shows an increase of 10,000 acres, nearly every county having a larger area this year, but it is doubtful if the whole of this is a genuine increase as there is some reason to suppose that growers last year did not in all cases make a full return of the small fruit grown under the trees in orchards.

Other Crops.—The area of other crops on the whole has increased, the only marked reductions being 10,000 acres in the case of rape, and 3,500 acres in that of linseed. Vetches or tares, with an increase of 25,000 acres has recovered a large part of the reduction of 49,000 acres recorded last year. The area of sugar beet shows a notable increase this year of nearly 6,000 acres, and the area under hops has been increased by over 1,000 acres.

Clover and Rotation Grasses.—The area of clover and rotation grasses which was increased by nearly 300,000 acres last year has now been reduced by 52,000 acres, and this year's total of 2,548,000 acres is practically the same as in 1921. The area reserved for hay is returned at 1,751,000 acres, this being 64,000 acres less than in 1923. The area of permanent grass for mowing is returned at 4,502,000 acres, or 145,000 acres more than last year, and the total area reserved for hay thus shows a net increase of 81,000 acres.

Horses.—The decline in the number of horses on agricultural holdings continues, the total of 1,232,000 returned this year being nearly 50,000 less than in 1923.

Cattle.—The total number of cattle returned is 5,893,000, an increase of 70,000 on last year's total. The number of cows and heifers in milk or in calf is 2,663,000, this exceeding last year's record figure by 48,000. There is a notable increase this year of 78,000 in the number of calves.

Sheep.—The total number of sheep this year is returned at 14,843,000, an increase on last year's total of over a million, the increase being about equally divided between ewes for breeding and lambs, the number of other sheep showing relatively little change.

Pigs.—The total number of pigs is returned at 3,227,000, this being the first time the three million mark has been reached. The increase on last year's total is no less than 615,000. The number of sows for breeding at 449,000 is also the largest recorded since this class was first distinguished separately in these Returns in 1893.

PRELIMINARY STATEMENT of Acreage under Crops and Grass.

DISTRIBUTION.	1924.	1923.	INCREASE.		DECREASE.	
	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Per Cent.</i>	<i>Acres.</i>	<i>Per Cent.</i>
TOTAL ACREAGE under all CROPS and GRASS	25,873,000	25,943,000	—	—	70,000	0·3
*ROUGH GRAZINGS	4,938,000	4,882,000	56,000	1·1	—	—
ARABLE LAND	10,928,000	11,181,000	—	—	253,000	2·3
PERMANENT GRASS {	For Hay ..	4,502,000	4,357,000	145,000	3·3	—
	Not for Hay ..	10,443,000	10,405,000	38,000	0·4	—
	TOTAL ..	14,945,000	14,762,000	183,000	1·2	—
Wheat	1,546,000	1,740,000	—	—	194,000	11·1
Barley	1,316,000	1,327,000	—	—	11,000	0·8
Oats	2,035,000	1,978,000	57,000	2·9	—	—
Mixed Corn	135,100	116,800	18,300	15·7	—	—
Rye	59,100	73,200	—	—	14,100	19·3
Beans	241,300	†235,000	6,300	2·7	—	—
Peas	171,500	†141,400	30,100	21·3	—	—
Potatoes	451,800	466,700	—	—	14,900	3·2
Turnips and Swedes	831,800	862,000	—	—	30,200	3·5
Mangold	389,600	402,900	—	—	13,300	3·3
Cabbage, Savoys and Kale	80,100	72,200	7,900	10·9	—	—
Kohl-rabi	14,700	12,600	2,100	16·7	—	—
Rape	63,100	78,000	—	—	9,900	12·7
Vetches or Tares	112,200	86,900	25,300	29·1	—	—
Lucerne	64,400	57,900	6,500	11·2	—	—
Mustard for Seed	35,900	31,200	4,700	15·1	—	—
Brussels Sprouts	20,700	16,900	3,800	22·5	—	—
Cauliflower or Broccoli	12,400	11,100	1,300	11·7	—	—
Carrots	10,700	10,100	600	5·9	—	—
Onions	2,900	2,400	500	20·8	—	—
Sugar Beet	22,800	16,900	5,900	34·9	—	—
Linseed	5,200	8,800	—	—	3,600	40·9
Hops	26,000	24,900	1,100	4·4	—	—
Small Fruit	73,500	63,700	9,800	15·4	—	—
Orchards	239,200	232,100	7,100	3·1	—	—
CLOVER and ROTATION {	For Hay ..	1,751,000	1,815,000	—	64,000	3·5
	Not for Hay ..	797,000	785,000	12,000	—	—
	TOTAL ..	2,548,000	2,600,000	—	52,000	2·0
BARE FALLOW	355,600	435,600	—	—	80,000	18·4

PRELIMINARY STATEMENT of Numbers of LIVE STOCK in England and Wales on 4th June, 1924.

	<i>No.</i>	<i>No.</i>	<i>No.</i>	<i>Per Cent.</i>	<i>No.</i>	<i>Per Cent.</i>
Horses used for Agricultural purposes (including Mares for Breeding)	782,300	798,100	—	—	15,800	2·0
Unbroken Horses {	182,300	206,900	—	—	24,600	11·9
(including Stallions) {	54,700	66,300	—	—	11,600	17·5
Other Horses	212,900	210,000	2,900	1·4	—	—
TOTAL OF HORSES	1,232,200	1,281,300	—	—	49,100	3·8
Cows and Heifers in Milk	2,013,900	1,974,600	39,300	2·0	—	—
Cows in Calf, but not in Milk	281,500	269,000	12,500	4·6	—	—
Heifers in Calf	367,300	371,200	—	—	3,900	1·1
Other Cattle :—Two years and above	987,000	1,018,500	—	—	31,500	3·1
„ „ One year and under two	1,084,100	1,108,200	—	—	24,100	2·2
„ „ Under one year	1,159,700	1,081,500	78,200	7·2	—	—
TOTAL OF CATTLE	5,893,500	5,823,000	70,500	1·2	—	—
Ewes kept for Breeding	5,989,800	5,505,200	484,600	8·8	—	—
Other Sheep :—One year and above	2,576,800	2,524,700	52,100	2·1	—	—
„ „ Under one year	6,276,400	5,805,600	470,800	8·1	—	—
TOTAL OF SHEEP	14,843,000	13,835,500	1,007,500	7·3	—	—
Sows kept for Breeding	448,800	388,500	60,300	15·5	—	—
Other Pigs	2,778,300	2,223,100	555,200	25·0	—	—
TOTAL OF PIGS	3,227,100	2,611,600	615,500	23·6	—	—

* Mountain, Heath, Moor, Down and other rough land used for grazing.

† In addition there were 4,900 acres of beans and peas grown for fodder in 1923.

The area grown for fodder in 1924 has not been separately distinguished in the Returns.

THE index number of prices of agricultural produce in England and Wales shows a fall of no less than 6 points this month, prices during July being on the average 52 per cent. above those in the corresponding month in the years 1911 to 1913.

The Agricultural Index Number. During May and June a rise occurred, and the general level of prices in the latter month was decidedly higher than last year, but the present reduction brings the figures again to approximately the same level as a year earlier.

In the following table are shown the percentage excesses over pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911-13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	61
March ...	189	150	77	59	57
April ...	202	149	70	54	53
May ...	180	119	71	54	56
June ...	175	112	68	51	58
July ...	186	112	72	53	52
August ...	193	131	67	54	—
September ...	202	116	57	56	—
October ...	194	86	59	51	—
November ...	193	79	62	53	—
December ...	184	76	59	56	—

Potatoes are the main cause of this month's fall, First Early potatoes, at an average of about £10 per ton, being in July only 81 per cent. dearer than in the corresponding month in the basic years. This figure is still high in comparison with those for most other kinds of agricultural produce, and is 15 points higher than in July last year, but it shows a very heavy fall from the figures of 219 and 174 per cent. above pre-war prices recorded in May and June respectively.

The reduction in potato prices is in itself nearly sufficient to account for the whole of the fall of 6 points shown by the general index number, and changes in other kinds of produce, although in some cases considerable, on the whole about balance. Wheat and barley both show advances, amounting to 5 and 4 points respectively, but oats are slightly lower; it must be remembered, however, that the prices for these cereals are based upon extremely small sales, and the producer has thus gained very little from the advance.

Fat cattle are somewhat cheaper, and pigs, in spite of a slight rise in price, show no change, owing to a similar rise between June and July in the years 1911 to 1913, but sheep show a further advance and averaged over the month very nearly double

their price in the corresponding month in the pre-war years. Since March of this year sheep have gained no less than 33 points, but it is noticeable that prices have actually advanced only $\frac{3}{4}$ d. per lb., the rise being chiefly attributable to the fact that between March and July in the basic years sheep fell from $8\frac{1}{4}$ d. to $7\frac{1}{4}$ d. per lb.

Store cattle fell slightly in July, as is usual at this time of the year, but the fall was much less marked than in pre-war years, and the index number shows a rise of 4 points. Store sheep also show an advance, for the third successive month, although July prices were actually decidedly lower than those of May and June, but store pigs have continued the decline which has been uninterrupted for over a year, and are now only 28 per cent. above pre-war prices.

Eggs at an average of 1s. $7\frac{1}{2}$ d. per dozen, showed a much greater rise than usually occurs between June and July, and the index number has risen 22 points, but poultry is cheaper, although still relatively dear at about 80 per cent. above pre-war prices. Butter advanced decidedly, the increase of $2\frac{3}{4}$ d. per lb. representing a rise of 17 points in the index number, and cheese also showed a rise for the third successive month, although in this case the rise is due to price changes in the basic years, as Cheddar cheese has remained practically unchanged at about 127s. to 128s. per cwt. at the wholesale markets since the beginning of the year.

Index numbers of different commodities during recent months and in May, 1923, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

Commodity.	1923.		1924.				
	July.	Mar.	Apr.	May.	June.	July.	
Wheat ...	39	46	38	38	42	47	
Barley ...	12	45	48	46	48	52	
Oats ...	41	39	35	30	32	28	
Fat cattle ...	45	52	49	51	55	54	
Fat sheep ...	72	64	75	87	93	97	
Fat pigs ..	54	33	35	32	31	31	
Dairy cows ...	49	64	63	58	59	55	
Store cattle ...	28	41	38	42	47	51	
Store sheep ...	109	85	84	96	121	132	
Store pigs ...	113	45	42	36	32	28	
Eggs... ..	36	68	48	40	43	65	
Poultry ...	79	59	70	87	93	80	
Milk	57	71	58	50	50	50	
Butter ...	37	63	51	40	43	60	
Cheese ...	54	71	71	77	83	90	
Potatoes ...	66	173	154	219	174	81	
Hay	38	1	0	4	3	1	

THE following Preliminary Statement compiled from the Returns collected on 4th June, 1924, shows the Acreage under **Acreage of Hops.** Hops in each County of England in which Hops were grown in 1924, with a Comparative Statement for the Years 1923 and 1922 :—

COUNTIES, &C.					1924.	1923.	1922.
					Acres.	Acres.	Acres.
KENT	East ... ..	...	...	...	3,660	3,540	4,100
	Mid ... ..	...	...	...	5,550	5,200	5,530
	Weald ... ..	...	...	...	6,870	6,720	7,110
	Total, Kent ...				16,080	15,460	16,740
HANTS ... ..	...	...	...	...	1,040	1,020	1,070
HEREFORD ... ..	...	...	...	...	4,100	3,890	3,950
SURREY ... ..	...	...	...	...	220	210	220
SUSSEX ... ..	...	...	...	...	2,390	2,260	2,350
WORCESTER ... ..	...	...	...	...	2,080	1,950	2,030
OTHER COUNTIES ... ..	...	...	...	...	100	100	90
Total					26,010	24,890	26,450

* * * * *

Foot-and-Mouth Disease.—The number of outbreaks of foot-and-mouth disease confirmed each week still averages 18, the total for the four weeks ended 17th August being 74, as compared with 71 for the previous four weeks published in the August issue of the *Journal*. In the week ended 27th July, 20 outbreaks occurred (1 each in Derby, Kesteven (Lincs), Worcs. 2 each in Bucks, Notts, Staffs, 3 in Dorset and 8 in Oxford); in the week ended 3rd August, 18 outbreaks (1 each in Dorset and Worcs, 2 each in Kesteven (Lincs), and Wilts, 3 each in Bucks and Oxford and 6 in Kent); in the week ended 10th August, 15 outbreaks (1 in Notts, 3 each in Bucks and Kent, and 4 each in Oxford and Wilts); and in the week ended 17th August, 21 outbreaks (1 each in Hants, Lancs, Notts, 2 in Bucks, 3 in Oxford, 4 each in Kesteven (Lincs) and Wilts, and 5 in Kent).

It is satisfactory to report that there have been only two new centres of disease in connection with the above outbreaks, at Gerrard's Cross (Bucks), on the 21st July, and in the Liverpool district (Lancs) on 11th August. In both these cases the origin of the disease is quite obscure. On 5 occasions, however, it has been necessary to extend already existing infected areas in consequence of outbreaks near the borders of those areas.

The total number of outbreaks from 27th August, 1923, to 17th August, 1924, is 3,271, involving 43 counties in England, 2 in Wales, and 12 in Scotland. The number of animals slaughtered amounts to 108,984 cattle, 51,549 sheep, 49,529 pigs, and 129 goats, the gross compensation being £3,494,000 and the estimated salvage £533,000.

REPLIES TO CORRESPONDENTS.

Manuring of Grassland.—J.O. refers to turves exhibited at the Yorkshire Show, showing effect of basic slag on pasture land, and asks whether a yearly application of 5 cwt. of slag on strong clay, that has had half a ton of 24 grade slag three or four times in the last ten years, would be a waste of money.

Reply: It is somewhat difficult to give a categorical reply. Speaking generally, 5 cwt. of slag each year following the heavy dressings of the last ten years would be rather on the extravagant side, and it would probably be advisable to follow the recommendation in the middle of page 4 of Leaflet No. 267 (Basic Slag), and wait until there are indications that a further dressing of slag is required. The County Agricultural Organiser is being asked to give further advice.

Eradication of Rest-harrow.—K.P. asks for information as to any practicable method of eradicating a weed known as Cammock or Cummock.

Reply: Cammock or Cummock appears to be a local name for Rest-harrow (*Ononis arvensis* L.). Long, on page 163 of "Common Weeds of the Farm and Garden," states that this "is in some localities a very harmful pest in pastures on poor heavy land, and some forms of it also on dry sandy and gravelly soils." The weed is a perennial and "must be attacked if in quantity by manuring, regular cutting and close depasturing with stock; in bad cases it may be necessary to plough up the pasture, give a thorough cleaning and manuring, and again lay down to grass in the usual manner." General directions for the cutting of perennial weeds are given on page 5 of Leaflet No. 112; for more detailed advice it would be well to consult the County Organiser.

Yields of Wheat from Single Grains.—L.R. refers to a statement made by the Member for Rutherglen in the House of Commons on 3rd July to the effect that he had raised "not merely the usual 80 grains from one seed but 1,000 to 1,500," and asks for information.

Reply: From quite early times* there are records of such yields. Professor Percival, of Reading University, in his monograph on "The Wheat Plant" (1921) refers to a statement by Everard in 1692 "that he obtained from single grains sown 10 inches apart, plants which produced 60-80 ears, the largest of which contained 40-60 grains, the best plants yielding over 4,000 grains. Tull, in 1731, refers to plants with 40 ears. In 1870 C. H. Shirreff found in his garden a single plant bearing 80 ears which yielded 4,524 grains." Professor Percival states that he has had plants bearing 60-70 ears and over 2,500 grains. He remarks that "in all these examples the plants were grown on soils in a high state of fertility and had unrestricted space for their development," and adds that "the necessary space required to secure these highly productive plants is not known, but it is certain that it is vastly greater than 10 square inches, the space which is allotted to each grain when one bushel (650,000 grains) is sown on an acre."

He gives a table showing, in the case of Swan wheat, the yields

* *Note.*—An early reference is Pliny the Elder (died A.D. 79), who records (Nat. Hist., XVIII x 95) from Africa "just under 400 stalks of wheat from one seed" and "340 stalks from one seed."

obtained from grains sown in spaces varying from 6 to 24 square inches. This table shows the yields per single plant consistently increasing and the yields per acre consistently decreasing with the wider spacing. In the 24-square inch spaces the yield was 354 grains per plant but only 5.73 bushels per acre, while in the 6-square inch spaces though the number of grains per plant was only 43, the yield per acre was 43.15 bushels. And he concludes:—

“In spite of the fact that under special circumstances thin-sowing may succeed, in practice it is found to be less hazardous to attempt to obtain an adequate number of ears per acre by thick-sowing rather than by thin-sowing and its concomitant tillering, especially when the amount of seed sown is far removed from that ordinarily sown.”

* * * * *

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Hertfordshire Institute of Agriculture.—Bulletin 3 :—The Necessity of Lime or Chalk in Hertfordshire. (8 pp.) Oaklands, St. Albans, 1924. [63.15.]

Pennsylvania Agricultural Experiment Station.—Bulletin 175 :—Forty Years' Results with Fertilizers. General Fertilizer Experiments. (23 pp.) Centre County, 1922. [63.16(04).]

Field Crops.

Reading University College and the Berkshire Agricultural Instruction Committee.—Bulletin 4 :—Results of Field Trials on the Manuring of Mangels, 1923. (7 pp.) Reading, 1924. [63.332.]

Reading University College and the Berkshire Agricultural Instruction Committee.—Bulletin 6 :—Result of a Field Trial on the Manuring of Swedes, 1923. (4 pp.) Reading, 1924. [63.332.]

Reading University College and the Berkshire Agricultural Instruction Committee.—Bulletin 5 :—Results of Field Trials with Potatoes in Berkshire, 1923. (15 pp.) Reading, 1924. [63.512.]

Pennsylvania Agricultural Experiment Station.—Bulletin 187 :—Soybeans : Their Culture and Uses. (15 pp.) Centre County, 1924. [63.321.]

South Australia Department of Agriculture.—Bulletin 181 :—Subterranean Clover (*Trifolium subterraneum*). (15 pp.) Adelaide, 1924. [63.33(b).]

Missouri Agricultural Experiment Station.—Circular 121 :—Inoculation for Legumes. (12 pp.) Columbia, 1924. [576.83.]

Horticulture and Fruit Growing.

Dyke, W.—The A.B.C. of Tomato Culture under Glass. (195 pp.) London : Lockwood Press, 1924, 3s. 6d. net. [63.513.]

Dyke, W.—Manures and Fertilisers incorporating formulæ by Dr. Griffiths for Special Manures for Garden and Greenhouse. (138 pp.) London : Collingridge, 1924, 4s. net. [63.16 ; 63.41 ; 63.5.]

Ohio Agricultural Experiment Station.—Bulletin 364 :—The Strawberry : Its Culture and Varieties. (pp. 60-98.) Wooster, 1923. [63.41(c).]

Plant Pests and Diseases.

University College of North Wales.—Preliminary Report on the Agricultural Zoology of North Wales by C. L. Walton. (28 pp.) Bangor, 1924. [63.292(42) ; 59.169.]

U.S. Department of Agriculture.—Dept. Bulletin 1239 :—Studies in the Physiology and Control of Bunt, or Stinking Smut, of Wheat. (29 pp.) Washington, 1924. [63.24.]

Nebraska Agricultural Experiment Station.—Research Bulletin 26 :—Effect of Environment on Potato Degeneration Diseases. (40 pp.) Lincoln, 1924. [63.23-33.]

The Journal

OF THE

Ministry of Agriculture

SEPTEMBER, 1924.

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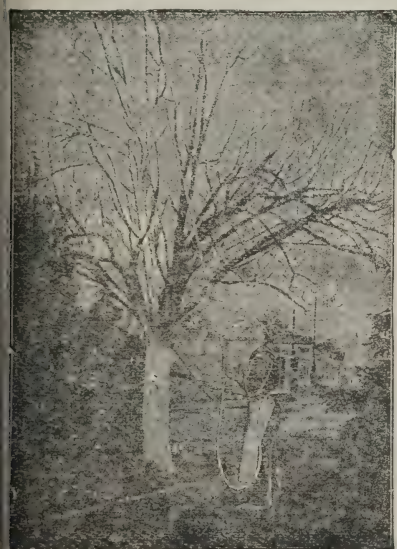
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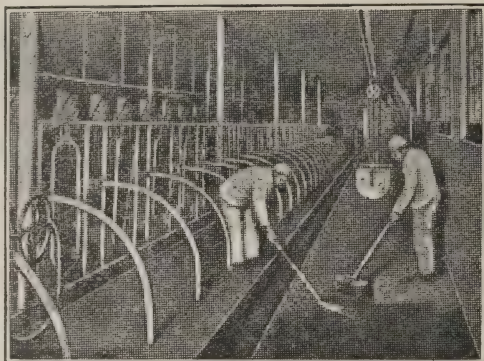
February	1923	- Bucket Sprayer, 4 gallons.
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February	"	- Spraying Machines to use.
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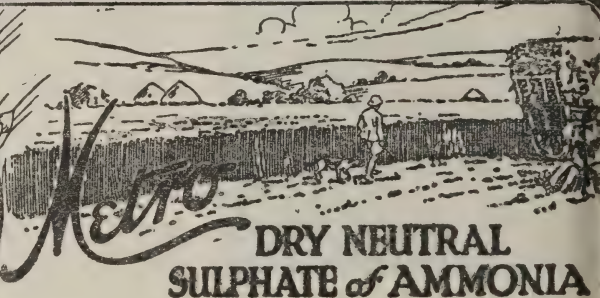
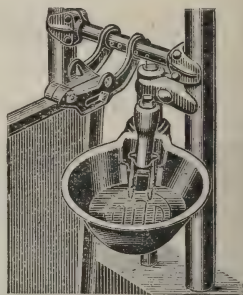
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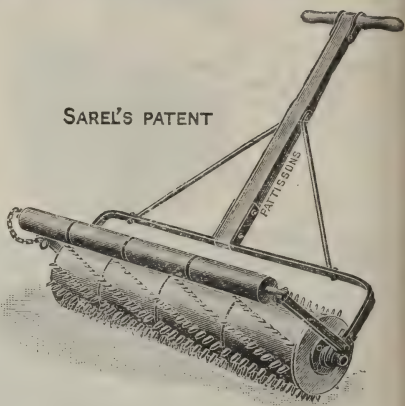
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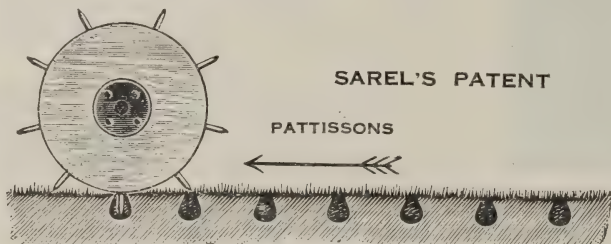
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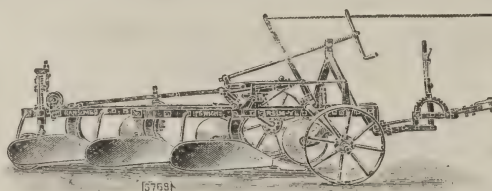
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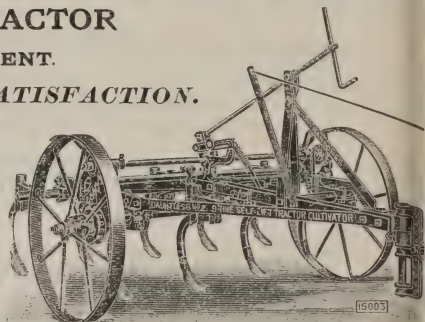
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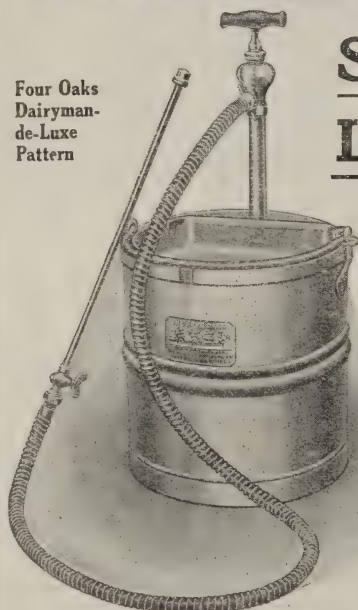
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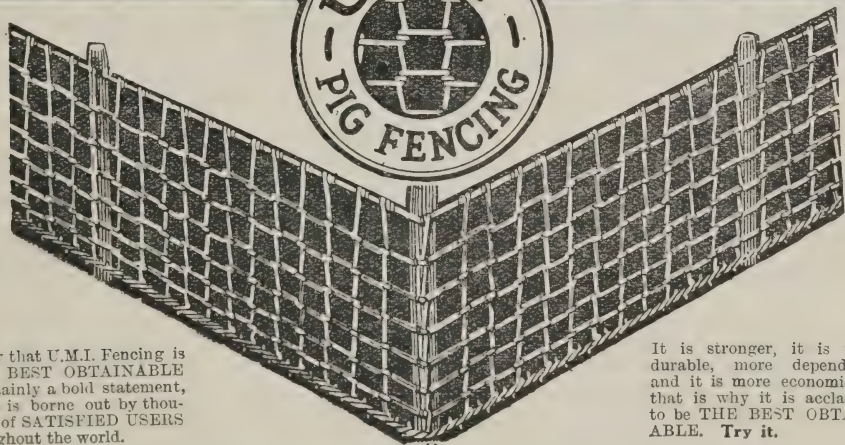
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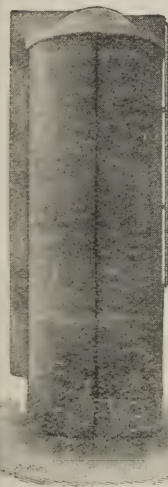
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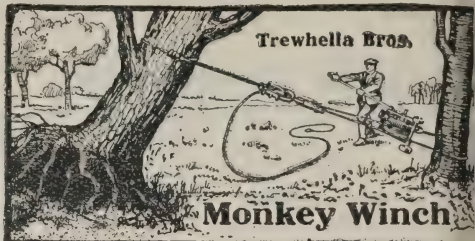
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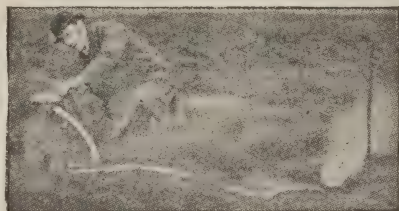
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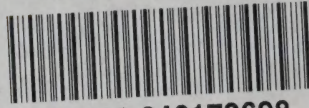
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